SCIENTIFIC AMERICAN

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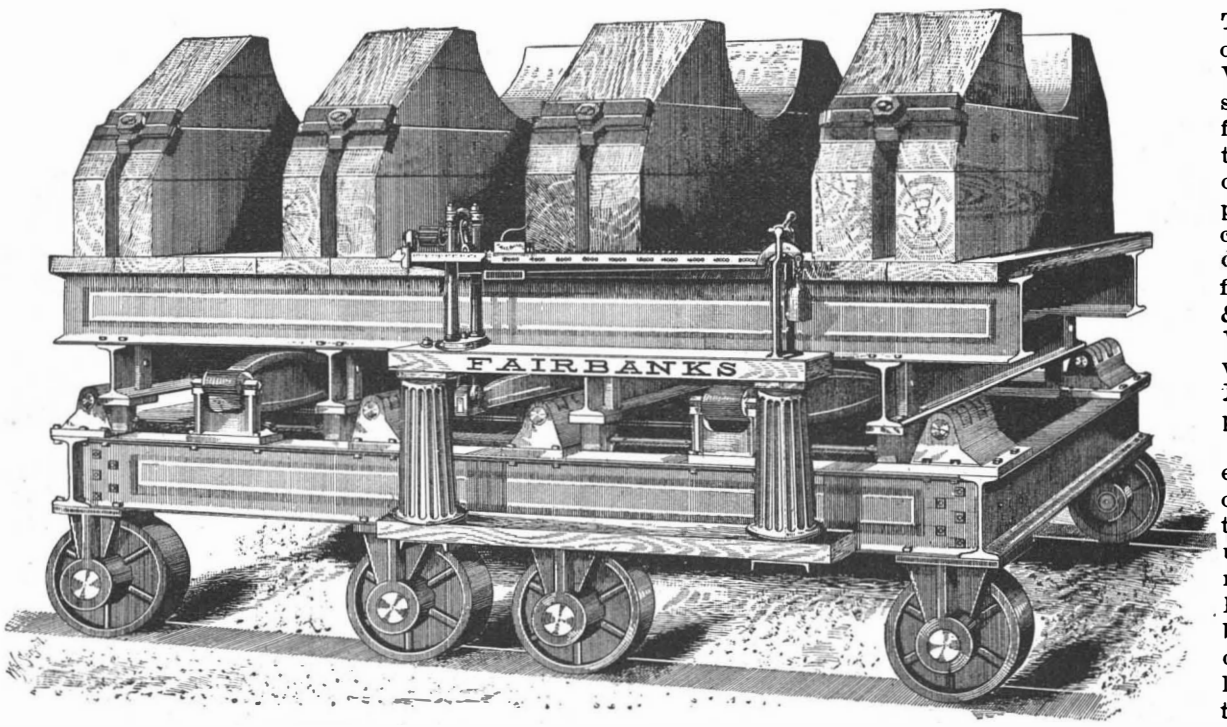
THE ONE HUNDRED AND FIFTY TON PORTABLE GUN SCALES OF THE WATERVLIET ARSENAL.

It is a trite saying that all modern science is built upon the balance. Modern chemistry developed its possibility of growth only when chemical balances began to be used in the laboratory. In physics, which is one of the sciences of measurements, the same truth holds. All the modern developments are due to the exact determination of weights and measures. Of late years the same fact has begun to hold in the case of the mechanical arts. The charges of flux and ore for the blast furnace and of steel for the crucible are now accurately weighed and precise results in metallurgy are obtained by the aid of scales.



DETAILS OF THE BEAM AND CONNECTIONS OF THE SCALE.

The same is true for many other branches of the arts. We illustrate in our present issue a portable platform scale, furnished by the Fairbanks Company, of New York, which is probably the largest of its class in the world. It was designed and built by the firm of E. & T. Fairbanks & Co., of St. Johnsbury, Vt., for use in the Watervliet Arsenal, near Troy, N. Y. It has a total capacity of 300,000 pounds.

The scale is carried on eight 20 inch wheels, four on a side. These support the lower bed frame built up of 12inch I-beams. Directly over each wheel is a link, the aperture in whose bottom forms the fixed fulcrum for one of the scale levers, there being eight of these main levers, four on each side. Above the cen-

THE ONE HUNDRED AND FIFTY TON GUN SCALE OF THE WATERVLIET ARSENAL.

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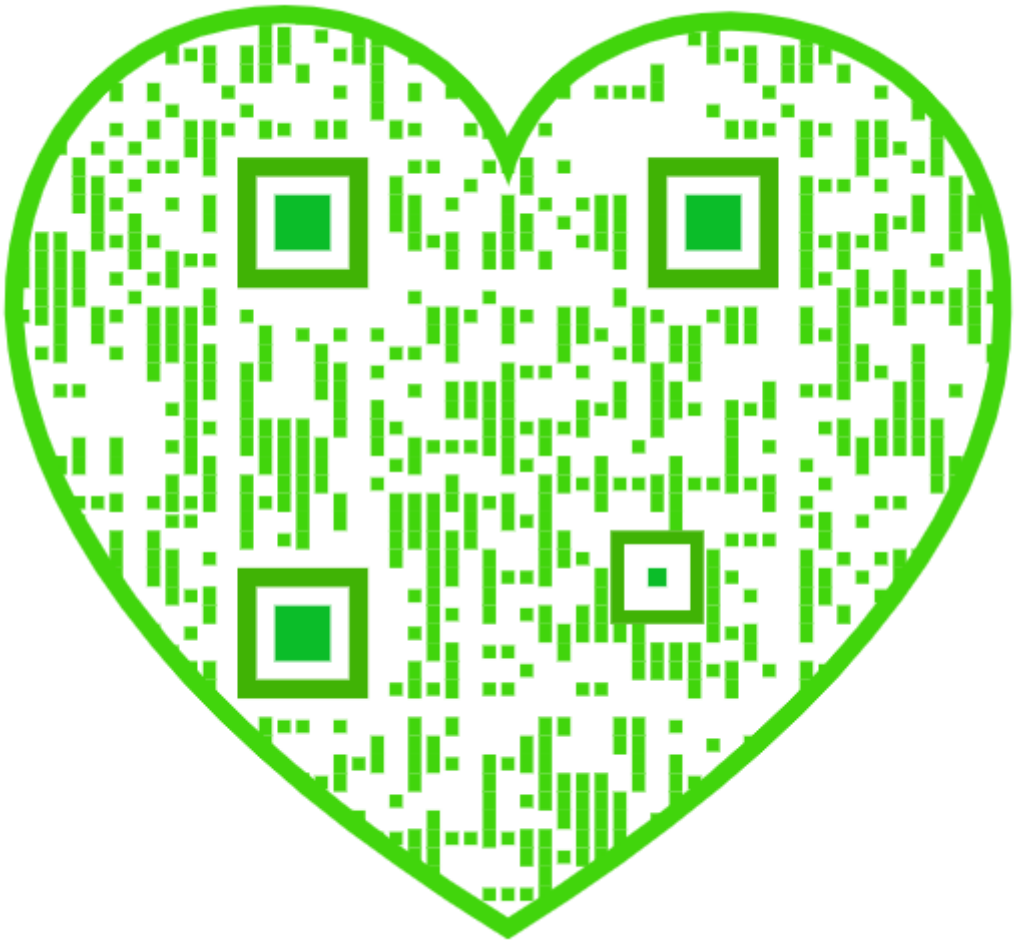

ter bearing or knife edge of each lever is an 8 inch I-beam running transversely, and 12 inch longitudinal I-beams, each 15 feet long, rest upon these 8 inch beams. There are, therefore, four transverse beams, each beam resting on two of the scale levers. The other ends of the scale levers, provided with knife edges, communicate by vertical links with a transverse lever, one of which levers answers for two main levers. For each pair of transverse levers, which nearly touch in the center longitudinal axis of the scale, is a second lever, this time a longitudinal one, of which there are two. The two ends of these levers, almost touching, operate a single transverse lever, which runs out to the weighing beam and is connected thereto in the usual way by links and knife edge pivots. From the original scale levers, which directly bear the weight of the platform to the weighing beam, there is, therefore, a series of three separate multiplications.

The weighing beam is of the peculiar type used only on the largest scales. The sliding poise reads directly to the large units, whose designations are engraved on the beam. On the poise is a subsidiary weighing beam, with its own smaller sliding weight, by which a reading to divisions of ten pounds is obtained, by inspection, which can by the eye be still further divided if desired.

Links are applied to prevent oscillation of the platform in either direction, but allow it perfect freedom of vertical motion.

The platform is 12 feet wide and 15 feet long. When loaded to its full capacity the scale undoubtedly represents the greatest concentration of weight under the circumstances on any portable scale ever built in this country. The platform is made of 3 inch oak, and on it are placed four chocks or blocks for the gun to rest on. Each chock has cut out of it a portion of a circle of 60 inches diameter. These chocks are spaced equally distant, each of them coming directly over one of the transverse I-beams, and, therefore, directly over the central knife edges of the scale levers. This is of itself a very interesting feature, and it has been found that however the weight of the gun is borne, whether by any pair of chocks or by all at once, the weight is given with precisely the same accuracy. To test the capacity, three guns were placed on it at once, making a total of 150 tons, which it weighed without difficulty.

As a practical illustration of what the scale would do once when a guu was resting on it and had been weighed, one of the officers of the Arsenal stepped upon the platform and while there he was weighed. Although the scale was loaded with thousands of pounds in the shape of the gun, the officer was weighed to within one pound of his known weight. A paper dollar bill placed on the end of the scale beam, when the scale is adjusted, is sufficient to disturb its equilibrium.

The object of making the scale so short was to enable it to be run across the building and off the main division of the floor, behind the row of columns seen on the left of the cut. A pair of channel beams, flat sides upward, are laid across the building for it to roll on. As we illustrate it, the scale holds a 12 inch gun weighing 52 tons.

Paints for Ironwork.

At a recent meeting of the Association of Engineers of Virginia, Mr. S. Wallis gave the members some interesting and valuable hints respecting the protective painting of structural ironwork. He recommended that the first coat should be of red lead ground in raw linseed oil, used within two or three weeks after mixing, and kept thoroughly mixed while in use. This coat dries in from 24 to 30 hours. If the finish is to be black, the next two coats should be made up from a paste composed of 65 per cent of pigment and 35 per cent of raw oil. The pigment is to consist of 65 per cent of sulphate of lime, 30 per cent of lampblack, and 5 per cent of red lead as a drier—the whole thinned to a proper consistency with pure boiled oil. If the finish is to be in red or brown, the paste should be composed of 75 per cent of pigment and 25 per cent of pure raw oil: the pigment to consist of 55 per cent of sulphate of lime, 40 per cent of oxide of iron free from sulphur and caustic substances, and 5 per cent of carbonate of lime as a drier. The sulphate of lime is to be fully hydrated. At American prices, this paint will cost, ready for use, about 60 cents per gallon. Lead paints are not recommended for finishing coats, on account of chalking; neither is zinc, on account of cracking. Graphite paint does not dry well in linseed oil, and is not impervious to water. Its color is steel gray.

Coloring Lantern Slides.

At a recent meeting of the Royal Society of Dublin, Sir Howard Grubb in the chair, Dr. J. Alfred Scott described a method, which he said he had devised, for coloring lantern slides, referring to that class of slides that are produced on photo-gelatine plates. The description of his method is in close accordance with that of Mr. G. M. Hopkins first published in the SCIENTIFIC AMERICAN of March 11, 1893. Dr. Scott will no doubt be glad to award the priority to Mr. Hopkins.

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ELEVENTH ANNUAL MEETING OF THE INSTITUTE OF ELECTRICAL ENGINEERS.

The American Institute of Electrical Engineers held their eleventh annual meeting in Philadelphia, beginning Tuesday morning, May 15, under the chairmanship of Prof. Edwin J. Houston, who was elected president of the society. The president's address was devoted to "A Review of the Progress of the American Institute of Electrical Engineers," and traced the work of the society during its decade of existence. Prof. Wm. A. Anthony spoke on "Light Distribution and the Use of Lamps." After the proceedings of the day were over, receptions were tendered the society by the Manufacturers' Club, by the Engineers' Club, and by the Electrical Section of the Franklin Institute. On Wednesday other papers were read and discussed. One was on "Some torage Battery Phenomena," by Prof. W. W. Griscom. He maintained that in this country storage batteries were worked to too close a margin. In Europe they have succeeded; here they have failed. Prof. Francis B. Crocker and C. Howard Parmly, of New York, presented a paper on "Unipolar Dynamos for Electric Light and Power." "Tests of Closed Coil Arc Dynamos," by R. B. Owens; "Relative Advantages of Toothed and Smooth Core Armatures," by Alton D. Adams, were among the papers read. In the evening the annual dinner was given. Thursday was devoted to various excursions and pleasure trips. The meeting was largely attended, nearly one hundred members sitting at the dinner. The papers were printed and copies distributed among the members, so as to enable better discussion to be given each one. The standing of the institute and the permanent form given to its volumes of proceedings operate to make its annual meeting one of the events of the year.

THE BICYCLE AS AN EXAMPLE FOR IMPROVEMENTS IN TRANSPORTATION.

For many years man has attempted the construction of a successful road machine to be propelled by the rider. The first signs of real success came in the application of crank propulsion to the old velocipede. The next development was the introduction of elastic tires of India rubber. Then came the last and greatest improvement, the pneumatic tire. Meanwhile the proportions and details of the machine were constantly changing, until the wheel of to-day was evolved, with its ball bearings wherever possible, and with air-inflated tires. The mere business of making and selling bicycles will soon be, if it is not already, one of the leading industries of the country.

Where he has to propel himself, man naturally has done everything to facilitate the work. The principle bearings of a bicycle, all except those of the chain gearing, work on hard steel balls, running with a minimum of friction and readily adjustable for end shake. The old solid rubber tire enabled the average rider to make high speeds; the modern pneumatic tire adds three or four miles an hour more to his rate. But while man has effected these improvements where his own individual exertions are concerned, does it not seem as if he had neglected to extend his ingenuity to horse, steam, and electrically propelled vehicles? An impression that the bicycle has engrossed all the time of the constructor and inventor of improvements in vehicles is created—the carriage and the rail car seem awaiting their turn.

The lessons of construction taught by the bicycle are valuable as much in their exclusion of the unsuccessful as in their lessons of achievement. It has been found that a machine with some twelve finely adjusted, apparently delicate ball bearings can, without repeated oiling or attention, be driven for hundreds of miles through dusty roads. It has been found that lightness of structure is made possible by the pneumatic tires, which prevent destructive jarring; every time a bicycle noiselessly glides past a rattling carriage, whose wheels rotate on thickly greased axles, and where every stone and inequality in the road opposes progress, seems to tell the story of the superior construction of the bicycle. Yet we are content to rest with the development of the man-propelled vehicle. It certainly is time something was done for the other.

A few solid rubber-tired carriages, still fewer pneumatic-tired vehicles, are seen upon our roads and streets. The pneumatic sulky used on the race track is a side issue. Roller or ball bearings are a rarity among carriages and on railroads. It is unquestionable that if it could be done, a veritable revolution in steam and electric transportation might be brought about by the further application of these improvements. It seems absurd to suggest a steam railroad car on pneumatic tires. But light short cars could certainly be carried on elastic tires of some kind, which would do away with the greater part of the noise and injurious jarring of iron wheels against steel rails.

The friction of car wheels is greatly diminished by roller or ball bearings. By every improvement in the direction of preventing jarring, lightness of construction would be favored. The whole system of transporting passengers in vehicles operated by steam or electricity is subject to radical modifications. The

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rail car, as now used, is open to criticism in many respects. Possibly the whole system of operating railroads may yet be changed. But it is hard to believe that the lesson taught by the bicycle cannot be of use to the railroad engineer. Elastic tires, light construction, almost frictionless bearings, should have some place in his economy.

Planet Notes for June.

BY H. C. WILSON.

Mercury will be "evening star" during June. On the 22d he will be at his greatest distance (elongation) east from the sun, and will set about an hour and a half later than that body. This month will be a good time both for daylight and evening observations of this planet. Its phase will be gibbous during the first half and crescent during the last half of the month. The moon will pass by Mercury on the evening of June 4, conjunction in right ascension occurring at 10 h. 32 m. central time.

Venus will be "morning star," rising about two hours before the sun. She is getting around toward the farther side of her orbit, so that her brightness is decreasing considerably. At the same time her phase is becoming more gibbous. At the beginning of the month 0·67 and at the end 0·76 of her disk will be illuminated.

Considerable has been said lately about the dark part of the disk of Venus being visible, just as the dark part of the new moon is visible. Several observers claim to have seen the complete outline of Venus' disk a few days before she disappeared in the rays of the sun this past winter, when her crescent was very narrow. We may say, I think, that this visibility is not from the same cause that renders the dark part of the moon visible, viz.: Reflected earthshine. Venus is more than 100 times as far as the moon from the earth, and, therefore, would receive less than the ten-thousandth part of the light thrown upon the moon. The most probable explanation is that Venus has a dense atmosphere, possibly more extensive than that of the earth, so that her twilight is longer, and extends far enough into the dark hemisphere to become visible from the earth as a complete ring of light when the crescent of direct illumination is small. The observer discerning the outline of the dark part of the planet, by this faint ring, would naturally have the impression of seeing it all.

Mars will be at quadrature, 90° west from the sun, June 17, and will be in position to be observed after midnight during this month. Mars will move northeast during June, from Aquarius across a little corner of Pisces into Cetus. The phase of the planet will be smaller this month than at any other time in the year, only 0·84 of the disk being illuminated. Mars will be in conjunction with the moon, about 3° south of the latter, 48 m. after midnight, June 25.

Jupiter and *Neptune* are not to be seen during June.

Saturn is making the turn of the loop in his apparent path among the stars of Virgo. He will begin to move eastward after June 21. The amateur should not fail to make the most of these summer months in the study of this planet. The surface markings on so bright a planet are almost as likely to be seen with a small telescope as with a large one. The moon will pass by Saturn, 4° south of the latter, June 12, at 2 h. 41 m. P. M. central time.

Uranus will be in his most convenient situation for observation during June, being near the meridian during the evening hours. He ought to be easily found by means of stars α and μ Libræ. Look about 1° 30′ west and 30′ north, *i. e.*, 3 diameters of the moon west and 1 diameter north, of α, for a star with a dull green disk a little brighter than the star μ.—*Popular Astronomy.*

Archæological Notes.

Prof. Waldstein, in giving his report to the managing committee of the American School of Classical Studies, at Athens, on the excavations made at Argive Heræum in 1893, under his direction, mentions a number of important results.

The work was directed upon the uncovering of the site of an ancient temple, perhaps the oldest in Greece. At one time 240 men were engaged. They found a portion of the temple wall a little over three feet in height by about forty-five feet in length. Very interesting specimens of bronzes, engraved stones, and pottery were unearthed. Vestiges of other buildings whose use is not yet determined were found below the temple terrace. Some indications point to their being the houses of the attendants of the temple. A portico which had at least nineteen pillars along its center, some of them found *in situ*, was uncovered.

Near by, an intricate building, which contained a number of rooms, offers a rich field for further study. Already a beautiful torso of a draped female figure, three marble heads, and other fragments have been taken from it. Terra cotta plaques, ceramics, bronzes, engraved gems, and glass scarabs were discovered in other parts of the same building. Parts of the entablature of a Doric building, with traces of colors, reds, blues, and greens, were also found. On the whole, Prof. Waldstein feels that further excavation on this site will undoubtedly lead to very valuable results. The inscriptions have been given to Prof. Wheeler for study.

The ruins at Delphi have yielded some important treasures in the past year. It is believed that among the remains of buildings some of the walls of the temple of the Pythian Apollo have been found. An archaic statue of Apollo in very good preservation had been used for building material. It is of more than natural size, in standing posture; the face is flat and triangular; the limbs are stiff and angular, the arms hang close to the sides and the fingers are closed. The hair falls in cylindrical locks upon the shoulders. It suggests Egyptian work, so different is it from the graceful Apollos of later time.

M. Homolle believes that the Treasury of the Athenians at Delphi, of which Pausanias wrote, has also been uncovered. He and his assistants are piecing together architectural fragments and sculptures which he hopes to prove belonged to that famous building. The sculptures show the grace and precision due to sharp and delicate execution. The building must have been small, though larger than the largest of the treasuries of Olympia. If M. Homolle can establish the correctness of his theory about this structure, he will give a most important date in the history of art.

A mound at Marathon has been so thoroughly investigated that there seems to be no doubt that it was erected over those who perished in the battle with the Persians.

Vases in black and red figured decoration, "Attic-Corinthian" and "Proto-Attic," point to the fact that not only was there a celebration after the funeral rites, but that probably annual celebrations were held on the field.

The British school working at Megalopolis is clearing the parliament house or *Thessilion* of the 10,000 Arcadians. It is a most interesting type of an early Greek building. The "columns radiate from the center, so as to obstruct as little as possible the view from all parts of the house, while they still preserve in their plan the lines parallel to the sides of the building necessitated by the structure of the roof."—*Condensed from American Journal of Archæology.*

Hard Water.

BY SIR BENJAMIN WARD RICHARDSON, M.D., F.R.S.

In many fashionable and, in many respects, beautiful and healthful watering places, much inconvenience is experienced from the hardness of the water. I could point to two famous seaside towns where real injury to health is the result of the hardness of the water. The visitor arriving there for change and rest finds himself for a few days much improved, owing to the change of air and repose from work. Then he becomes low-spirited, is dyspeptic, feels himself distended with gases in the stomach and intestines, sleeps indifferently, is constipated, passes a large quantity of pale urine, is somewhat hysterical, and declares that the place, much as he may admire it, does not suit. Sometimes he feels pain in the stomach, rising up on the left side to the shoulder, and speaks of his liver being sluggish. He takes alteratives, but they do not relieve him, and he leaves, condemning the place for some fault he does not understand. In nine cases out of ten, all these symptoms are due to hardness of the water, and to nothing else.

The favorite sea resorts where this fault occurs ought to know this fact. Brighton ought to know it; Eastbourne ought to know it; Bournemouth ought to know it. These towns spend large sums on means admirably intended to make their visitors comfortable; but they fail in this one particular, vital as it is. They fail also without any reason, for they have the means at their command for remedying the evil at once, if they would only take the lesson. The governing body of every town where the water is hard should send a committee to the city of Canterbury to learn the simple method of softening the water by the Porter-Clark process on a large scale. Canterbury is not a fashionable watering place, but it has set the example of rendering healthful one of the grand necessities of life—drinking water. The inhabitants of that city have all their water supplied to them at four degrees of hardness, and the result is excellent in every way.

Hard water produces the temporary symptoms named above. It does more: taken for a long time, it causes derangement in the function of the kidney, and is very favorable to the deposit of stone in the bladder. It also interferes with the proper infusion of vegetable substances, like tea and coffee, and causes incrustation of vessels in which water is boiled. For ablution and for baths it is very objectionable, and it gives to the laundress much unnecessary trouble. So much the more important is it, therefore, that in all places, but in resorts of health particularly, it should be properly softened and made a surer means of cleanliness as well as of constitutional invigoration.

How to Soften Water at Home.—The above opusculum suggests to me to describe the late Mr. Alderman Hallett's mode of softening water on a small scale. It is very practical. Place near together two two-gallon stoneware casks. Fill one with the hard water, a half pint of lime water being first put in. After standing twenty-four hours the supernatant water will be as clear as at first, and at the bottom of the vessel will be found a precipitate of chalk. The shape of the vessel is best if cylindrical, with the tap-hole a short distance up the side. This form of vessel allows the process to be completed within twelve hours. The second cask (or vessel) is provided to insure a reserve of softened water while the other is being treated. No weighing of lime is required. The lime water is obtained by putting into a stoppered bottle fresh caustic lime, and water is to be poured on it to fill the vessel. In a few hours the upper part of the fluid is quite bright, and is saturated with lime. The charge of caustic lime need not be renewed oftener than every two or three months. If it is objected that the quantity is small, more vessels can be used, or larger ones, so as to meet the requirements. There is also an advantage in having the water only stored a day or two during hot weather, since on standing it soon ceases to have a brisk taste. Persons who are liable to irritation of the mucous membrane from hard water quickly derive benefit from the continued use of this softened water for drinking purposes.

The softening process might easily be adopted by laundresses by using large casks; the saving in soap would well repay them for a little trouble.

1 cwt. lime will do the work of 20¼ cwts. soap.
Cost of 1 cwt. quicklime, 8*d.*
Cost of 20¼ cwts. soap, £47 1*s.* 8*d.*

There is, therefore, very little question that the adoption of some such mechanical means of mixing, combined with a rapid filtering of the separated chalk, is soon paid for through the large saving in soap alone.—*The Asclepiad.*

Destructive Fires.

Several disastrous fires have lately taken place by which property to a large amount has been destroyed. On Sunday, May 12, soon after the morning service was over, a fire broke out in the organ loft of the great church of Dr. Talmage, Brooklyn, N. Y. In a very few minutes the entire edifice was in flames, which spread with astonishing rapidity to the adjoining buildings, one of which, the magnificent new hotel known as the Regent, was soon destroyed. Several dwelling houses were also damaged. The fire in the church was supposed to be due to a spark from one of the electric attachments of the organ. The loss on the church is $350,000. Loss on Regent hotel, $850,000. Loss on other buildings, $150,000.

On May 15 a fire kindled by boys underneath the grand stand of the Boston Baseball Club set fire to that structure, which created such an intense heat and spread so rapidly to adjoining buildings that three fire engines had to be abandoned and were lost in the flames. The adjacent buildings were mostly dwellings of wood, and the fire licked them up with amazing swiftness. Nearly twenty acres were burned over, embracing over a hundred buildings, rendering five hundred families homeless. Loss, $500,000.

May 12 the barrel house of Emery's refinery in Bradford, Pa., took fire, presumably by spontaneous combustion. The loading racks and five oil tank cars standing on a side track of the Buffalo, Rochester & Pittsburg road were also burned. A dome of the iron tank was shot up into space 300 feet, and came down with a crash an eighth of a mile away.

Search Lights and Torpedo Boats.

A test of the value of search lights for naval purposes was lately made at the naval station, Newport, R. I. It was arranged that during the evening of the 15th inst. the torpedo boats Cushing and Stiletto should endeavor to enter the harbor while search lights should be employed in detecting them if possible.

The Cushing was painted nearly a black, while the Stiletto was left a dark green. The test took place at 9:30 in the evening. The boats entered the range of the search light and passed to their anchorage while the officers were still looking for them at the entrance to the bay. For ten minutes the boats were in the open channel, but the deep color of the vessels blended with the color of the rocky shores so they were not detected.

In general, the search lights may be depended upon to show up the presence of vessels at a distance, but in this case there was a failure.

Remedy for Onion Maggot.

Half a pint of kerosene is well mixed with a pailful of some dry material, preferably wood ashes. but sand, sawdust, or even dry soil will do fairly well, and after the plants are well up and the trouble is at hand a sprinkling of this mixture along the rows about twice a week during the time the fly does its work will be found a sure preventive.

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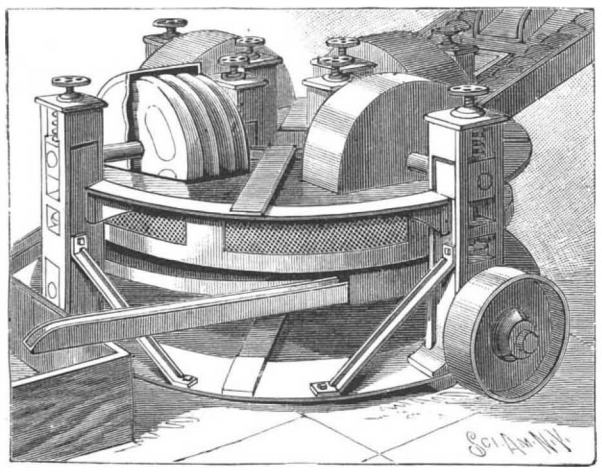
AN IMPROVED ORE CRUSHER.

This machine, adapted to crush gold, silver, or other ores, forms the subject of a patent recently issued to Mr. Frank Bishop, of No. 1265 Washington Avenue, Ogden, Utah. Its circular base carries four sets of posts, in which are journaled four horizontal radial shafts, two of these shafts having on their outer ends pulleys connected by belting with a suitable source of power. On each of the shafts is a step pulley, and on these steps of the four pulleys rest similar steps on the under side of a circular ring-shaped bed, near the outer edge of which, on the under side, is a gear wheel or rack in mesh with gear wheels on the power shafts. On the top of the bed is a facing on which the crushing of the ore or stone takes place, and in the facing

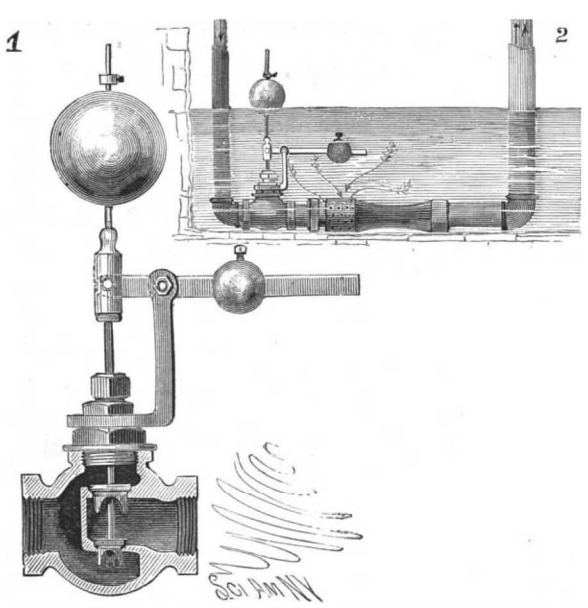


BISHOP'S ORE CRUSHER.

are concentric annular V-shaped grooves, corresponding to oppositely shaped ridges on the peripheries of the four crushing rollers. The latter are on radial shafts arranged in line with and supported by the four sets of posts in which are journaled the lower shafts, but the boxes in which are journaled the shafts of the crushing rollers have a vertical movement, springs being arranged to press upon the tops of the boxes with a tension which may be regulated by a set screw at the top of the post over each bearing, each roller, therefore, having such yielding movement as may be desired, according to the material being crushed. The upper half of each roller is inclosed by a suitable casing, one of the casings being partly broken away in the illustration, and the bed has an outer and inner annular flange, circular screens being attached to the upper edges of these flanges, against which the crushed material is thrown by the centrifugal force of the revolving bed, only that which is sufficiently fine being passed through the meshes of the screens. Scrapers suspended from the roller casings guide the material on to the corrugated facing in advance of the rollers, the material being fed from a hopper by means of screw conveyers, and introduced through suitable feed openings in the base. The outer lower edges of the screens extend into semi-ring shaped receiving troughs or spouts, which lead the material discharged to settling tanks. This machine is designed to crush a large amount of ore with a minimum expenditure of power.

AN AUTOMATICALLY OPERATING EJECTOR.

In the improvement shown in the illustration, patented by Mr. Nicholas Power, of New York City, the valve is perfectly balanced by an adjustable counterpoise to remain in whatever position it is placed by a float, which controls the action of the valve. Fig. 1 is a sectional view through the valve, and Fig. 2 shows the improvement in connection with an ejector, as it might be placed for draining cellars and similar purposes. The ejector may be of any of the well known types, connected at one end with a discharge pipe and at the other end with a supply or pressure pipe. The



POWER'S EJECTOR.

valve has an upper and lower seat, and the two valve disks are mounted on one stem, on the upper end of which is a block to which is coupled a rod carrying a float. The block is also attached to the inner end of an arm pivoted upon a bracket supported by the casing, the arm carrying an adjustable weight. The float on the rod coupled to the valve stem slides freely, its upward movement being limited by an adjustable collar on the rod, and its downward movement by the block on the upper end of the valve stem. When the float exerts upward pressure on the collar the valve will open, and it will close when the water lowers so that the float strikes the block.

Further information relative to this invention may be obtained of Mr. P. Braender, No. 263 West 118th Street, New York City.

The Stuff we are Made of.

Take the case of a lovely human face. It may be asked, "What can science say about this without detracting from its charm?" If beauty were only skin deep, we might dread her interference here. But science says that beauty is not skin deep. She can tell you that half the charm of that face—at least the expression—is a matter of little muscles and a complex labyrinth of nerves. That the curves of the lips, the glance of the eyes, the droop of their lids, are a matter of the prevalent use of certain small muscles in obedience to a prevalent aspect of the mind. Moreover, that the use of these organs of expression has come down long ancestral lines, and that the mould of the features themselves is a question of heredity. "What is life?" is a question with which men have puzzled themselves in vain from all time. We are not concerned with an inquiry after an entity which, perhaps, has no more separate existence than the old *phlogiston*, or principle of fire, of the alchemists. But what does concern us most truly is the process of living, and, in discussing the stuff we living beings—men, animals and plants—are made of, I shall try and lead my readers a little way into those mystic haunts tenanted by those tiny elves to whose ceaseless activity, from the dawn of life upon this globe to this day, are due all those embodiments, in endless variety, of energy and beauty, without which the world would be a desolate wilderness—a place, indeed, of blue sky and sea of sunrises and sunsets, of majestic mountains and mirroring lakes, of rocky shores and foam-fringed beaches; of many colors and tints, indeed, but without verdure or blush of life, or any sound, save the beat of the waves and the sigh of the wind, like an endless lament that earth and sea had missed the purpose of their creation. A little child's idea of his body is that of a trunk, head (with mouth, etc.), legs and arms, and, practically, grown people—at least those who enjoy good health—go no further in their analysis. But the truth is that that which we call ourselves is the sum of a countless host of tiniest lives, each tiny life contributing its tiny share to the maintenance of that marvelous and complex organization known as a living body. As soldiers make the stuff of which an army consists, as citizens are the stuff of which a state is made, so the stuff which goes to make not only ourselves, men and women, but everything that has breath and life, and the stuff which goes to the moulding of those exquisite creatures of form and color and perfume—the flowers, as well as of the ancient fathers of the forest, that stuff consists of living particles.—*Sunday Magazine.*

Fireproof Buildings.

A writer in the New York *Recorder*, commenting on the destruction by fire of the Rev. Dr. Talmage's Tabernacle, in Brooklyn, adds:

What is fireproof?

Iron isn't, because it melts in fierce heat, and in less heat expands. Thus an iron beam between two walls may expand so much as to throw one of them down. Stone isn't, because in fierce heat it crumbles away to dust. The material which is most nearly fireproof is good brick. The more it's baked, the harder it gets. So the best fireproof buildings have brick terra cotta walls, floors of hollow brick, and doors and casings only of wood. Even then a fireproof building will burn if a very hot fire attacks it from the outside. But a fire starting in one of the rooms only burns up what's in that room and stops. It never gets very hot.

In such a fire as that in Chicago or Boston, the best of buildings would be damaged greatly, even if they did not fall.

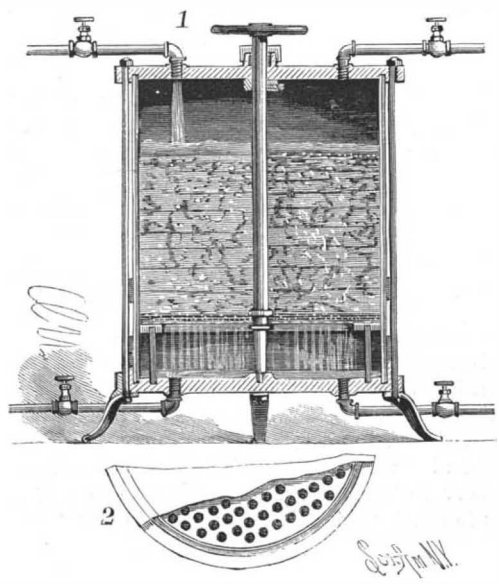
Wood, when it is thin, burns very rapidly, but in big beams it doesn't catch fire so readily.

So, in ordinary wooden buildings, it is the hollow spaces between the lath and the walls and floors that carry the fire out of sight like so many chimneys until it is ready to burst through. These hollow floors are one of the greatest dangers in fire. The stairway, with its wooden stairs, and the elevator shaft, if there is one, are the points of greatest danger, because they draw the fire up like chimneys.

That is why, in case of a fire pretty well started, it is always better to go out by the fire escape instead of the stairs.

A SIMPLE AND EASILY CLEANED FILTER.

The filter shown in the illustration is designed for either high or low pressure, and is especially adapted for filtering water used for drinking purposes, being arranged to facilitate the thorough cleaning of the filtering material whenever necessary. It has been patented by Mr. Frederick Bommarius, No. 734 N. Rampart Street, New Orleans, La. The cylindrical casing is closed by heads connected by screw bolts. Rods extending up a short distance from the lower head support a ring on which is seated a revoluble screen on a vertical shaft whose lower end turns in a step on the upper side of the lower head. The screen is readily removable, being held between a collar and jam nut on the shaft, on whose upper end is a hand wheel, by which the screen may be revolved, a collar secured on the shaft by a set screw abutting against the under side of the upper head, and preventing the screen from being unseated by upward pressure. The screen is preferably made of two perforated plates with a wire netting between them, as shown in Fig. 2, and on it is placed the filtering material. The water to be filtered is passed through one of the valved pipes into the upper end of the casing, the filtered water being withdrawn by a valved pipe leading out from the space beneath the screen. To clean the filter, the valves in

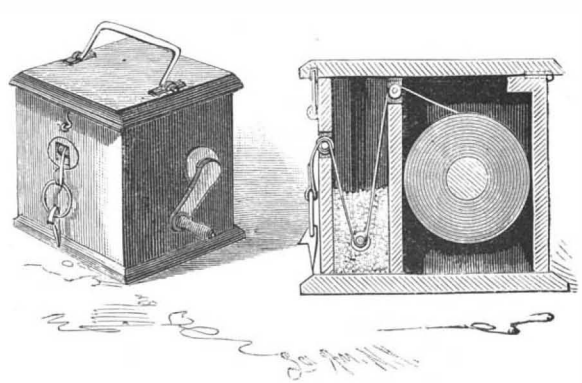


BOMMARIUS' FILTER.

both these pipes are closed, and water under pressure is admitted to the lower side of the screen from another valved pipe, the water passing upward and out through a corresponding outlet pipe at the top. While this process of washing is going on, the hand wheel is turned to revolve the screen, causing the loosening of the filtering material and the breaking up of previously formed channels.

A CONVENIENT LINE CHALKER.

This is a device for holding and keeping in a cleanly and compact way the chalk line used by carpenters, gardeners, and others, and automatically and evenly chalking the line. In practical work it has been found very satisfactory, having but few parts, being inexpensive to manufacture, and not liable to get out of order. The improvement has been patented by Mr. Carl E. Anderson, Wood's Holl, Mass. The box or casing is divided into two compartments, as shown in the sectional view, and journaled in one compartment is the reel or spool on which is wound the chalk line, on the outer end of which is a ring carrying a sharpened pin or peg—the ring to be hooked to a nail or other projection, or the peg for securing the end of the line to a wall, or the ground, etc., as may be desired. The other compartment of the casing contains the powdered chalk, and is narrowed at its bottom by inclined side strips, forming a V-shaped receptacle, so that the chalk always feeds down to the middle of the



ANDERSON'S LINE CHALKER.

bottom. In a slot in the top of the partition between the compartments is a guide pulley over which the line passes, and thence down around a similar roller in the bottom of the chalk chamber, passing out of the box over a roller in its front wall. As the line rises out

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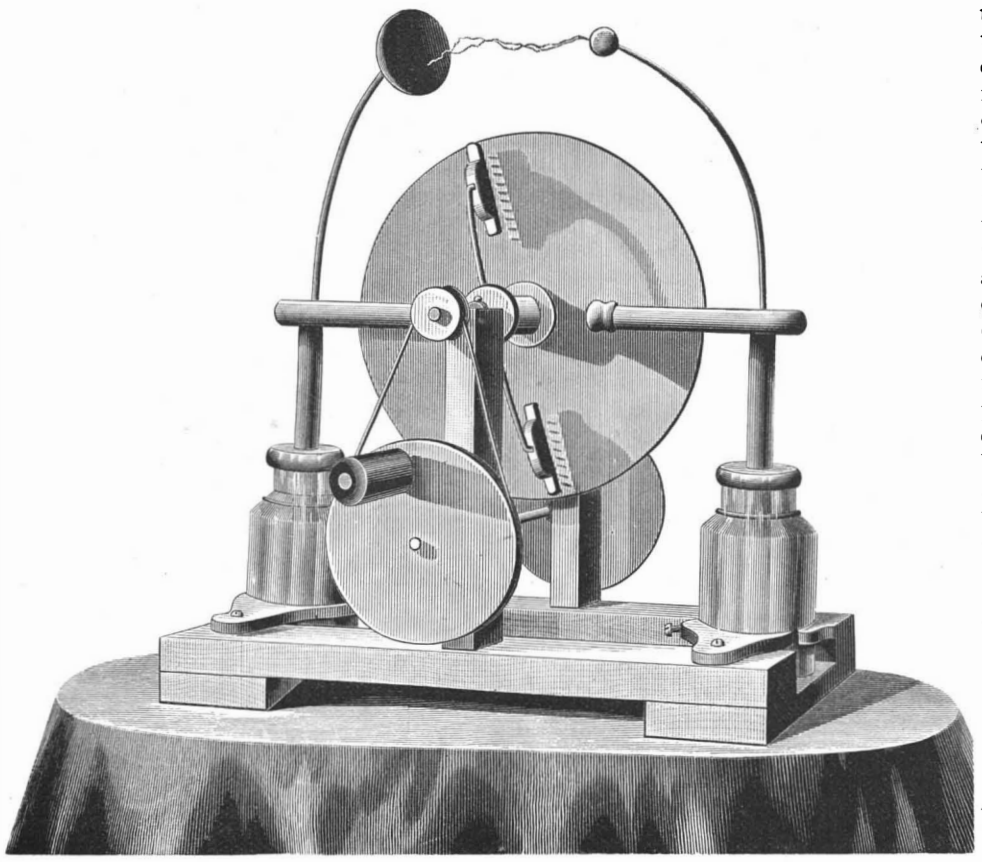
of the chalk, all surplus chalk is removed by a loop-bar scraper. The roller in the chalk chamber may be readily removed when it is desired to use the device without chalking the line.

PICOLET'S WIMSHURST INDUCTION MACHINE WITHOUT SECTORS.

To the Editor of the Scientific American:

Having read an article in the French weekly *La Nature*, of April 14, stating that the Wimshurst machine made without sectors is something new in the way of influence machines, I take the liberty of asking your attention to a description of a machine of my invention which I constructed in 1892. It is like a Wimshurst machine of the disk type, only the plates have no sectors on them, and where the brushes of an ordinary sector machine would be combs are placed parallel to the plane of the brush-holders, and extending from near the edge to about the length of half the radius of the plates. The collectors cover the same part of the radius as the combs, and in other respects are like those on a Wimshurst machine. The positive pole terminates in a small ball, and the negative pole in a small disk.



PICOLET'S WIMSHURST'S INDUCTION MACHINE WITHOUT SECTORS.

As nothing touches the disks, I think that my machine, as respects wear and friction, is superior to Mr. Bonetti's, and although mine is imperfectly made, it gives very good results. The plates are 5 inches in radius, and the greatest distance that a spark can jump across is, under favorable conditions, 5¾ inches.

I inclose a diagram to illustrate how the machine works. In the diagram, the smaller circle represents the front plate of the machine, and the larger circle represents the back plate.

A and B are the collectors, C and D the combs facing the front plate, and E and F the combs facing the back plate.

The machine can be started by holding a positively electrified body, an electrophorus for instance, near the front plate, opposite the comb, E, while the disks are revolving. This positively electrified body acts inductively on E, attracting negative electricity on to the plate opposite E, and repelling positive electricity through F on to the plate opposite F. By the rotation of the back plate, the negative electricity from E is carried to the collector A, and the positive electricity from F is carried to the collector B. Now, while the negative electricity is being carried to A it comes opposite C, and attracts positive electricity to the plate opposite C; and in the same way, while the positive electricity is being carried from F to B, it comes opposite D, and attracts negative electricity to the plate facing D. The positive electricity from C is carried to B, and the negative electricity from D is carried to A. The electricity that is now on the front plate acts on the combs facing the back plate in the same way as that on the back plate acted on the combs facing the front plate; and thus the electricity on one plate induces electricity on the other, so that they keep up a reciprocal action. This action is maintained as long as the plates are made to rotate, and is accompanied by a powerful discharge of sparks between the electrodes.

The distribution of electricity on the two plates is shown in the diagram by plus and minus signs. The signs farthest from the center of the plates correspond to the electricity on the back plate, and the signs nearest the center to the electricity on the front plate.

May 4, 1894. ANDRE J. PICOLET.

ELECTROSTATIC INDUCTION MACHINES WITHOUT SECTORS.

The improvement made by Mr. Wimshurst in electrostatic induction machines through the construction, in 1883, of the one that bears his name, is well known.

This machine is formed, in principle, of two parallel disks of insulating material, glass or ebonite, provided with numerous sectors. The disks have rapid rotary motion in different directions. The difference of potential developed manifests itself between two conductors connected with insulated combs arranged on diametrically opposite sides of the disks and embracing the two disks on each side. Mr. Bonetti has simplified the construction of the Wimshurst machine and increased its discharge by omitting the metallic sectors of the disks and increasing the number of the brushes. It is the practical realization of an idea brought out for the first time, we believe, by Mr. George Pellissier in 1891 in the *Journal de Physique*.

The machine thus modified is represented in Fig. 2. We find therein all the elements of the Wimshurst machine, less the metallic sectors glued to the disks, plus supports that permit of making the brushes slide over the diametral conductors. The disks may be of glass or ebonite, but the latter material, which is less hard and fragile, is generally preferred. The machine is not excited automatically, but by rubbing one of the disks with the finger covered with a little mosaic gold. The direction of the current, once determined, cannot change. The machine is non-reversible. No inversion is produced while running unless the other disk is rubbed at a symmetrical point. This fixedness of the current and the facility of rapidly and surely effecting its inversion constitute valuable qualities in therapeutics.

The discharge also can be varied within wide limits

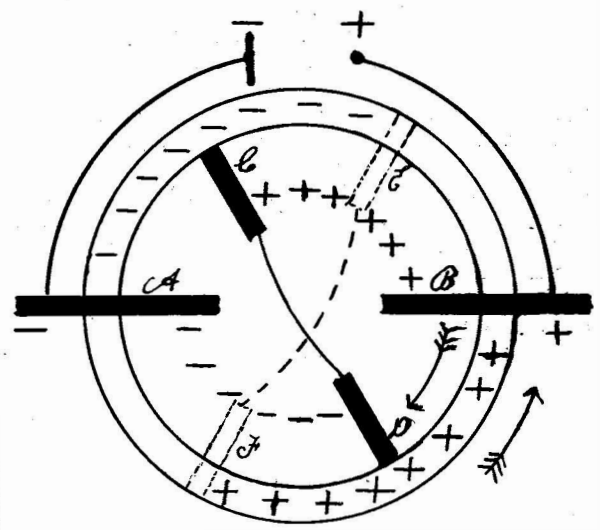


DIAGRAM ILLUSTRATING THE ACTION OF PICOLET'S MACHINE.

either by suppressing some of the brushes or by shifting their points of contact upon the disks. When the entire surface of the disk is brushed by the metallic pencils, the discharge is maximum. Measured by the Lane electrometer, it is, according to Mr. D'Arsonval, three times greater than that of a Wimshurst machine of the same dimensions provided with sectors. Upon shifting the brushes in order to make them touch the same zones, the discharge is reduced in proportion with the reduction of the surface brushed.

The suppression of the sectors has led to another advantage relative to the maintenance. The plates destitute of sectors are more easily cleaned, and the brushes last longer, since they do not rub against metallic sectors, which wear them away in themselves being worn away, and which become deteriorated and torn.

The principle of the Wimshurst machine without sectors has been likewise applied to a more powerful machine, represented in Fig. 1, and in which the disks are replaced by two concentric ebonite cylinders, whose mean diameter is 50 centimeters and whose common height is 50 centimeters. These two cylinders, separated by a distance of a few millimeters only, are mounted upon two thick ebonite disks fixed upon concentric shafts with ball bearings and actuated by friction wheels. Series of external and internal combs and brushes, arranged according to generatrices, replace the radiating combs and brushes of the disk machine. Fig. 1 represents the machine as it operated

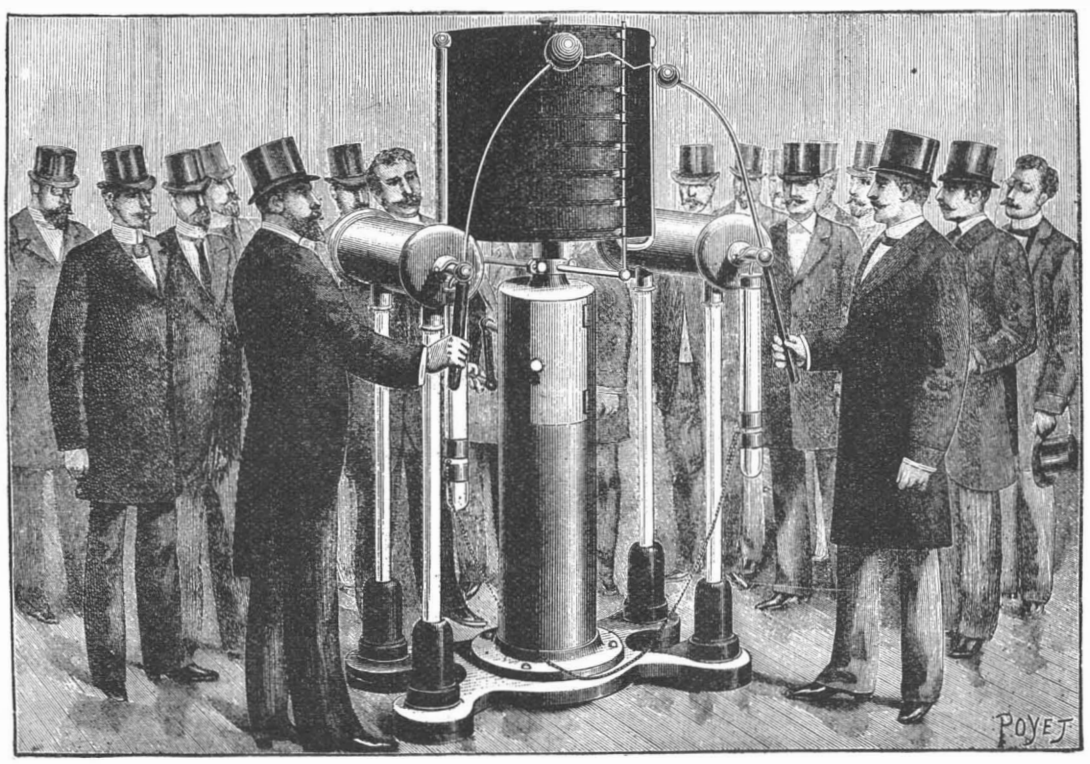


Fig. 1.—BONETTI'S CYLINDRICAL WIMSHURST MACHINE.

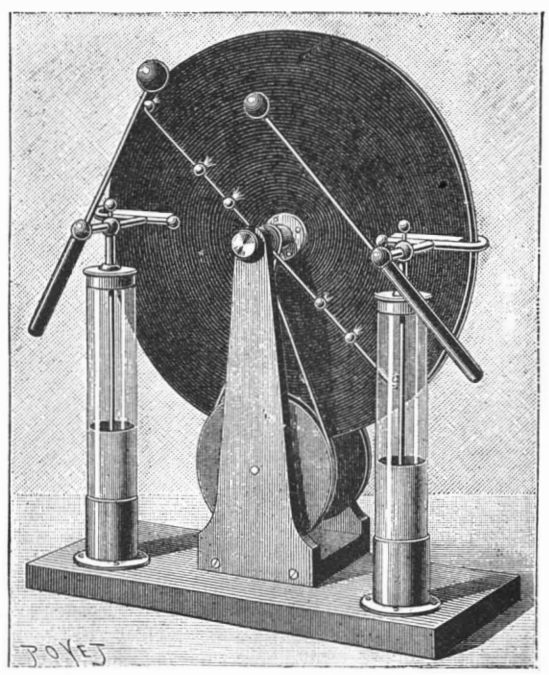


Fig. 2. ELECTROSTATIC INDUCTION MACHINE WITHOUT SECTORS.

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during the Easter sessions of the French Society of Physics.

The machine thus established produces powerful and noisy sparks and discharges whose effects appear to be much superior to those of the most improved older types, but of which it is difficult to indicate the order of magnitude in default of comparative measurements and of experiments expressing the results obtained in C. G. S. units. Such want, which we should like to see supplied, contributes in a certain measure to perpetuate the belief that there exist profound essential differences between the machines called electrostatic and the dynamo-electric ones outside of their mode of action, while in reality they both produce electro-motive forces, intensities and powers that differ only in the order of magnitude. —*La Nature.*

The Craig Colony for Epileptics.

The Legislature of New York State has passed and the Governor signed the bill establishing a colony for epileptics in that State. The colony is named after the late Oscar Craig, president for some years of the State Board of Charities. The bill provides for the purchase of a tract of 1,875 acres of beautiful land in the Genesee Valley, near Mount Morris, in Livingston County. This tract is all in one piece, well watered by brooks, and consisting of fine fields, woodland and orchards, and already provided with picturesquely grouped buildings to the number of thirty-five. It has been a colony of the Shakers for twenty or thirty years, and is, therefore, perfectly adapted to its new use.

The law requires that all of the buildings put up shall be on the village plan. A board of five managers is provided for, and these have already been appointed. Governor Flower, in order to make the new charity as ideal as possible, decided to select a specialist on nervous and mental diseases as one of the managers, so as to insure the best scientific treatment of patients and to keep the resident medical men in touch with all the latest developments in the pathology and treatment of epilepsy. He also appointed a lady residing within a few miles of the colony as one of the managers, in order that the women and children and general housekeeping can be kept under constant surveillance. In addition a lawyer, a homeopathic physician and an editor were added to the board. The managers serve without salary and meet at the colony once or oftener monthly. Having these ends in view, the Governor appointed as the board of managers, Dr. Frederick Peterson, of New York; Mrs. C. F. Wadsworth, of Geneseo; Geo. M. Shull, of Mount Morris; Dr. Chas. E. Jones, of Albany; and W. H. Cuddeback, of Buffalo.

An important provision in the bill is that the managers may accept any bequests of persons interested in the welfare of epileptics, and it is believed that many charitable wealthy people will build cottages upon the splendid sites on the tract to bear their names and exist as lasting memorials to their desire to serve humanity in this wise.

A medical superintendent, steward, matron, pathologist, nurses, school teachers, teachers of various industries and arts, and so on, are to be appointed as needed; but the colony will not be ready probably to receive patients before the autumn of 1895.

It is thought that the colony will ultimately number fifteen hundred to two thousand members. As soon as possible the six hundred epileptics in the county almshouses will be taken in charge. Later private patients will be received at prices corresponding to the accommodations asked for. It is sure to become self-supporting in the course of time, and to grow into an industrial and agricultural village that will more than rival the similar and famous colony at Bielefeld, Germany, upon which this is, to a certain extent, modeled.

At their organization in Albany, on the 3d of May, the board of managers made Dr. Frederick Peterson, of New York, president, and George M. Shull, of Mount Morris, N. Y., secretary of the board.

Magnetism of the Earth Illustrated.

Mr. Henry Wilde, F.R.S., of Manchester, has a theory that the exterior of our earth is permanently magnetic; also that an interior one is movable and magnetic, rotating in the plane of the ecliptic, 23½ degrees, and loses one revolution in 960 years, or 2·25 of a degree annually; he assumes, also, that the internal sphere is electro-dynamic. At a recent conversazione of the Royal Society he exhibited two globes, one within the other, and each containing a coil of insulated wire, through which currents of electricity could be sent, and mounted so that their motions should be such as to agree with his hypothesis. By placing a compass over different parts of the outer globe, he obtains the same variations and dip as are found in nature; so considers that he has proved his case, or at all events has done so until some better hypothesis is brought forward.

Prof. Silvanus Thompson exhibited some illustrations of polyphase electric currents, among which one of the most striking was the revolution of a copper egg in a rotary magnetic field; it could not get out of the field.

Mr. Henry A. Fleuss exhibited a mechanical pump for the rapid production of high vacua, and vacuum tubes exhausted by it. It was a double-barreled air pump worked by a driving wheel turned by hand, but the essential part of it he keeps secret; all he says is, that in the valvular part is a special heavy oil, totally free from water.

Mr. J. W. Kearton exhibited several of his magic mirrors on which no image was visible to the eye; but when light was thrown upon them from an electric lantern they cast reflected images upon a screen. His mirrors owe their peculiar properties to curved elevations and depressions in the polished metallic face, the elevations producing figures in shade by scattering of light, and the depressions figures in light by condensing rays reflected from the mirror on to a screen. The figures in relief and intaglio are first produced by the action of any suitable acid on the metal plate, and are then polished down until they disappear to direct vision, after which the surface of the mirror is electro-gilt.

Mr. Killingworth Hedges exhibited a model of his method of transmitting force by spheres or balls. Instead of water as a medium, balls, each having a crushing strain of fifteen tons, are used; and any pressure on one end of the row of balls is at once transmitted positively to the other, the tube in which they are contained running round corners, and up and down in the same way as the hydraulic pipe. At the bends the tube containing the row of balls has to be made with care, and to be very smooth inside.

Fruit Growing in Florida.

Florida has an exceedingly vigorous horticultural society, which held its seventh annual meeting in Jacksonville on the 10th of April. *Garden and Forest* says: The two hundred active members who assembled were welcomed by the mayor, who encouraged them by some eloquent remarks on the importance of fruit growing and other branches of horticulture. President W. W. Adams illustrated this fact by stating that the orange crop alone amounted to five million boxes, while peaches, pears, and tomatoes were leaving the State by the car load, and there are preparations already made in the State to furnish train loads of all these in the near future, while there are orange groves enough planted to produce in a few years twenty million boxes. Mr. Adams claimed that the depressed condition of the fruit trade was not due to overproduction, because the crop of oranges now produced would only furnish one orange a month to each inhabitant of the United States. The business, however, had outgrown the facilities for transportation, and something must be done to enlarge these facilities and economize in transportation, or the future of fruit growing in Florida would be without hope.

Mr. George H. Wright reported that in Orange County grape growing began some seven years ago, and last year there were five hundred acres in cultivation. The low price received in 1893 had reduced the acreage somewhat. Refrigerator car service was necessary to make growing grapes for market profitable, otherwise the grapes must be converted in to wine. He advised against planting any more Niagaras, and on sandy soil such varieties as Herbemont, Norton's Virginia, Cynthiana, were recommended. He thought that vineyards should be set on higher land than had been previously recommended. The vines should have clean culture until June 1, and a complete fertilizer, one which contained ammonia, phosphoric acid, and potash, should be freely used. Growers from western Florida stated that grapes in that region set on high and well drained soil had done well. Some growers declared that their products had reached Northern markets in such good order as to realize reasonable returns. The experience of others was less satisfactory, and many of the members claimed that, on the whole, grape growing, beyond raising enough for family use, was not an industry to encourage.

A large pineapple grower of southern Florida had found scrub pine land to be the best adapted for this fruit, and the varieties which were the most profitable were the Egyptian Queen, strawberry, and the scarlet pine. From 12,000 to 15,000 plants could be set out on an acre, and sixty per cent of these would fruit the second year, while the next year some of the plants would have from three to five fruits each. Mr. Richards, who is known as the pineapple king, states, in reply to an inquiry as to how long the plants would bear, that he had been in the business fourteen years, and his plants now looked better than they did five years ago.

The fruit committee called attention to a formidable rival of Florida which was much nearer than California; this was the coast region of Texas, where an area equal to the entire peninsula could be utilized for growing subtropical fruits. During the last twenty-five years the progress of fruit growing in both these States had been so rapid, and they had so many interests in common, that it was proposed to hold a joint meeting of Texas and Florida horticulturists to devise the best means of uniting for mutual benefit.

Professor Swingle, of the State Experiment Station, reported that he had discovered a speedy and easy way of making a sulphur solution which had proved an effective remedy for the rust mite and red spider which attacked citrus fruits. The formula is 32 pounds of flowers of sulphur made into a paste, with 12 quarts of water, 20 pounds of caustic soda 98 per cent strong, and 4 quarts of water, which are thoroughly mixed and then diluted to 20 gallons. Two quarts of this to a barrel of water should be used for the rust mite and 4 quarts for the red spider. Against the white fly, which causes what is known as smut on the orange and is now the occasion of some alarm, the following remedy was recommended by Professor Webber: Four and a quarter pounds of caustic soda, 20 pounds of resin, 3 pints of fish oil, and 20 gallons of water are put in an iron kettle, and when dissolved are boiled ten minutes. When the mixture is cooled it should be used in the proportion of one part diluted with five parts of water. This is effective against scale of all kinds and the red spider, and is just as valuable for deciduous trees as for the orange and lemon. The cost of this mixture was estimated at half a cent a gallon of spraying material when ready for application.

It was generally agreed that in applying fertilizers high grade mixtures were to be preferred. Some of the members advised planters to buy the different materials and mix them at home. Others believed that it is equally as cheap to purchase the prepared fertilizer from reliable firms. It is evident that more experience is needed with commercial fertilizers as well as with homemade manures before definite conclusions can be stated in regard to their use in this region.

After all, the topic of paramount importance was that of transportation and transportation rates, and the statement that a barrel of flour could be brought East for one-third of the price which it costs to transport a box of oranges West was cited as an instance of unjust discrimination. The resolution to favor the bill now before Congress to open the coasting trade to vessels carrying foreign flags caused such a heated discussion that the society adjourned with some bitter feeling on both sides.

How to See Cataract in your Own Eye.

The following simple method enables a patient to see a cataract in his own eye and note its growth and development, probably better than any oculist can observe it for him.

Cataract is said to be due to the gradual deposition of oxalate of lime in the substance of the crystalline lens, at first in small spots or streaks, sometimes in one part and sometimes in another. The deposit gradually increases until it penetrates the whole of the lens, causing blindness. The remedy, then, is to remove the lens, and after its removal the patient needs a substitute in the form of highly magnifying spectacles.

All that is necessary to enable a patient to see his own cataract for himself is a piece of card and a needle --a visiting card will do very well. Pierce a clean round hole near the middle of the card and hold the card up to the light close to the eye, looking preferably in the direction of a piece of blue sky. With the card near to the eye, the patient will not see the small hole pierced by the needle, but he will see a comparatively large faintly illuminated field with his cataract projected upon it. He is, in fact, observing the shadow cast by his cataract on the retina at the back of his eye. With a small puncture in the card the shadow so thrown is comparatively sharp. But with a normal eye an evenly illuminated field or clean disk will be seen. The patient may thus map down his own cataract, and settle for himself whether it is extending and whether he will have an operation or not. None of the oculists I have seen have known of the method, and there may, consequently, be some advantage in making it public.—*J. S., in Knowledge.*

Modern Chemical Science as an Aid to the Police.

A Buda-Pesth manufacturer has informed the police that he possesses a powder with which thieves can be caught. Having for the last few days made the unpleasant discovery that his cash box was plundered day after day, and failing in all his attempts to catch the thief, he applied in his dilemma to Mr. Telek, professor of chemistry at the Franzstadt Commercial Schools, and the latter gave him a powder which he sprinkled over his cash every night before leaving the office.

This powder has the peculiar effect of dyeing the skin blue, the color being intensified by washing, while it resists the application of soap. On the very first day the manufacturer noticed a deficiency of eight crowns in the silver cash box. He at once called his employes together and ordered them one by one to steep their hands into a basin full of water, got ready for the purpose. One of the men was very loth to follow the example of his comrades. At last he consented, when, no sooner had he dipped his hands in the bowl, than they turned dark blue! His employer stepped up to him and said: "You are the thief!" and the man at once confessed.—*Anhaltischer Staats-Anzeiger.*

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Correspondence.

Venus' Fly Trap.

To the Editor of the Scientific American:

The interesting story about the Venus' fly trap on page 265 of the SCIENTIFIC AMERICAN, April 28, 1894, which represents that plant as being able to distinguish between animate and inanimate matter, lacks some elements of truth, if it includes that variety which grows in North Carolina—and I have never heard of any other kind.

There are on each lobe of the trap, down near the line of junction, two small hair-like spines which are the triggers of the trap, and nothing can throw it without touching one of these. A single touch is sufficient to throw the trap. The location of these spines renders it impossible for a fly or any other small insect to spring the trap until it is in such a position that the closing will entirely envelop it. There is no need of any "second stimulus," and the plant cannot distinguish the touch of a fly from that of any other object, living or dead.

These plants are numerous in my native county, and I have always found it more agreeable to watch their pranks, and those of their neighbors, the trumpets (Sarracenias), than to "fret" myself "because of evil" political "doers." B. F. GRADY.

House of Representatives, U. S., Washington, D. C.

[FROM THE NEW YORK SUN.]

Arcturus, the Greatest of all Suns.

Since Sirius has practically disappeared with the progress of the year the brightest fixed star in sight is Arcturus. It is worth while for anybody to take the very slight trouble needed to find Arcturus, for who would not wish to see what is, perhaps, the greatest sun contained in the visible universe? I suppose everybody knows the figure of the "Dipper" in the sky. At this season, about 9 P. M., it is nearly overhead in the north, its handle being to the east and its upturned bowl to the west of the meridian. Follow the curve of the handle to the end and extend it with a similar curvature for a distance somewhat exceeding the entire length of the Dipper, and you will find Arcturus. There is not the slightest danger of missing or mistaking it, for there is no star in that part of the sky possessing one-quarter of the brightness of Arcturus. A soft reddish tinge distinguishes its light from that of all its fainter neighbors. This reddish hue, which I believe to be variable, has a peculiar significance, as we shall see.

The statement will be found in some of the old schoolbooks that Arcturus is probably one of the nearest of the stars. As a matter of fact, it is one of the most remote of those whose distance is measurable. It must be admitted that the few measures that have been made are very discordant, and in what follows I shall assume the correctness of the results obtained by Dr. Elkin. The measurement of the distance of a star is a very beautiful problem, and the fundamental principle is perfectly simple. It depends on the revolution of the earth around the sun. On the 1st of January the earth is about 186,000,000 miles from the place it will occupy on the 1st of July, because on those two dates it is at opposite points in its orbit, and the distance across the orbit is 186,000,000 miles. The diameter of the earth's orbit thus serves the purpose of a surveyor's base line. It is plain that the direction in which a star is seen cannot be exactly the same from both ends of that line unless the star's distance is so immense that the diameter of the earth's orbit bears no measurable ratio to it. Most of the stars are so distant that that ratio cannot be ascertained, but there are a few whose apparent places are appreciably different when viewed from the extremities of our 186,000,000 mile base line. According to Dr. Elkin, the position of Arcturus is thus shifted to the amount of 0·018 of a second of arc, and this is called its parallax. How exceedingly delicate the methods employed in measuring such a quantity must be can, perhaps, be understood when it is stated that 0·018 of a second of arc is equal to the apparent distance between the heads of two pins placed one inch apart and viewed from a distance of 180 miles!

Having ascertained the parallax of a star, the next step is an easy one. Multiply the earth's distance from the sun, 93,000,000 miles, by the number 206,265, which is a mathematical constant that I shall not here undertake to explain, and divide the result by the parallax of the star. The quotient will be the star's distance in miles. If we apply this rule in the case of Arcturus, we have

$$\frac{19{,}182{,}645{,}000{,}000}{0{\cdot}018} = 1{,}065{,}790{,}250{,}000{,}000$$

miles. In round numbers, one thousand millions of millions of miles, or about 11,400,000 times the distance of the sun from the earth. The reader may jot down in his notebook the number 19,000,000,000,000, leaving off the less significant figures we have used above, and it will always enable him to ascertain the approximate distance in miles of a star whose parallax is given, this number being used as a dividend, and the parallax, expressed in the form of a decimal fraction, as a divisior.

Now, having found what Arcturus' distance is, another simple calculation will enable us to compare the actual amount of its light with that of the sun; in other words, to say how much greater a sun than ours it is.

Various estimates have been made from time to time of the light which we receive from certain of the brightest stars compared with that received from the sun. It is probably fairly accurate to say that the sun sends us about 25,000,000,000 times as much light as Arcturus does; in other words, that it would take twenty-five thousand million stars as bright as Arcturus to make daylight on the earth.

But, as everybody knows, the intensity of light decreases with increase of distance. If we were twice as far away from the sun as we are, we should get only one-quarter as much light from it as we do; if we were three times as far away, we should get only one-ninth as much light, the light varying inversely as the square of the distance. Situated where we are, the sun gives us enormously more light than Arcturus does; but we have just seen how enormously further away than the sun Arcturus is. Let us suppose, then, that the earth could be removed to a point half way between the sun and Arcturus. In that case those two shining bodies would be on equal terms so far as distance was concerned. Which, then, would give the greater light to the earth? Arcturus, unquestionably. The real distance of Arcturus is 11,400,000 times the real distance of the sun; but at a point half way between them the sun's distance would be 5,700,000 times greater than it now is, while Arcturus' distance would be diminished one-half. But since light varies inversely as the square of the distance increases, the sun's light would be diminished the square of 5,700,000, or 32,490,000,000,000, while that of Arcturus would be quadrupled. Now, glancing back we see that in the present position of the earth the sun's light exceeds Arcturus' light in the ratio of 25,000,000,000 to one; but with the earth half way between them the sun's light has diminished, as a result of increased distance, 32,490,000,000,000 times, and Arcturus' light has increased, through decrease of distance, four times. Multiplying together these two numbers, and dividing the product by 25,000,000,000, we get 5,198, which is the number of times that the light of Arcturus exceeds the sun's at an equal distance; so that Arcturus is really, as far as radiating power goes, equal to 5,198 such suns as ours!

Does the heat of Arcturus exceed that of the sun in the same ratio? Very likely it does. If, then, we were as near to that giant star as we are to the sun, we should be not only blinded, but burned up. The frame of the earth itself would melt and dissolve and burst into a cloud of fiery vapors. If we suppose that the intensity of the radiation of Arcturus is the same as that of the sun per unit of surface, Arcturus must be about seventy-two times as great in diameter as the sun, and about 375,000 times as large in volume. Its diameter in miles is, on that supposition, no less than 62,350,000! Imagine all the planets of our solar system removed to Arcturus and set revolving around that star in orbits of the same size as those in which they travel around the sun. Poor little Mercury, when in perihelion, would be plunged more than 2,500,000 miles beneath the blazing surface of that marvelous sun; neither Venus nor the earth nor Mars nor Jupiter would be able to withstand its overwhelming heat. Even Saturn, at a mean distance of 855,000,000 miles from the surface, would also be overwhelmed with that mighty outpouring of radiant energy; Uranus, 1,750,000,000 miles away, would be a most torrid and unendurable place of abode, if, indeed, it would be habitable at all, and Neptune, a thousand million miles more distant still, would broil under a fervid temperature nearly six times as intense as the mean temperature that the sun now imparts to the earth. If Arcturus is surrounded by inhabited worlds, it is plain that they must keep a very respectful distance between themselves and their solar ruler, or else they are inhabited by beings whose blood would freeze in their veins during a midsummer day in the Desert of Sahara.

We have some knowledge also of the kind of sun that Arcturus is. It belongs to a separate family from that of our orb of day. Leaving out of account their difference of magnitude, they are as unlike as an elm and an apple tree. I have spoken of the red tinge visible in the rays of Arcturus; the analysis of its light indicates that it is surrounded by a vast mantle of metallic vapors, enormously deeper and more extensive than the similar surroundings of the sun, shutting out an immense quantity of light, while at the same time the surface of the huge globe within glows with a greater intensity of heat than prevails on the sun. There is some reason for thinking that the screen may eventually be stripped from the face of this wonderful star, and that, as Sirius has done, it may change from red to white. Such a change might imply a tremendous increase of radiation. In 1852 its light suddenly paled, and the dazzling whiteness of its rays astounded those who had observed the change. In a few years it became red again. Its color is paler now than it has been in past years. This spring it has sometimes appeared to me to have almost parted with its familiar ruddy yellow tinge. What do such mutations import?

It would surely be worth the risk involved if we could place ourselves within easy observing distance of Arcturus, and study the play of solar energies there on a scale which dwarfs even the gigantic phenomena of the sun. And possibly the improvements that the coming century will undoubtedly bring to the telescope, the spectroscope, and other instruments of research will enable us to approach Arcturus in effect, if we cannot in fact; for man already sits like a god upon his little earth, and reaches out to the orbs that surround him. GARRETT P. SERVISS.

The Rail Industry in England.

In his recent presidential address before the Iron and Steel Institute, Mr. E. Windsor Richards said:

Never since the organization of this institute has the metallurgist experienced a more difficult time than the depression we are passing through. Added to his commercial troubles are constant demands from the workmen for either higher wages or fewer hours of work. The gravity of the situation demands the closest consideration of commercial men and of statesmen. We may well anxiously look round to see where the markets for our produce and employment for our workmen and capital are to come from. Great hopes are entertained at home that the tariff laws in America will be so altered and improved in our favor that we shall be able to resume delivery of iron and steel to that country. But American legislators are perfectly well aware of the needs of their own country, and know quite well that their own industries must first be fostered, and employment found for their own people. We may rest perfectly assured that they will legislate in that direction, and not in favor of England or any other country to the detriment of their own. We should not turn our eyes either so much to America for a market, for they have experienced a far greater degree of depression than we have. Nor must we look to Continental nations to take our iron and steel, for they are well able to supply themselves; and if present tariffs are not sufficient to keep out our productions, they will be increased. We cannot and do not complain of countries fostering their own industries, but we claim to exercise our privilege of grumbling when these tariffs are so high as to enable our competitors to poach on our lands and throw our workmen out of employment, and especially when, by placing even a small quantity of iron and steel in Great Britain, they depress the value of the whole of our products, and we have reason for complaining of a competition which is so one-sided and unfair to our manufacturers.

But we must look to our own possessions and to our own colonies for relief, and our legislators must safeguard their interests and ours. Canada is thoroughly loyal to us, and needs our markets as much as we need her to take our surplus population. We look anxiously for further development of railways in India and Australia, and Africa should, ere long, become of enormous advantage to us. It is to be hoped that our legislators may find time to consider these important questions, which affect the well-being of so many thousands engaged in the iron and steel industries, and are, indeed, of vital interest to the whole of the community.

The invention of our venerated and most highly esteemed past president, Sir Henry Bessemer, conferred the greatest good on the greatest number, but even he could scarcely have imagined that steel rails would be put on board ship at £3 12s. 6d. per ton. The manufacturer, not being included in the category of the greatest number, would perhaps not complain so much of the price if he could obtain enough employment to keep his workmen together until times improved. One cannot wonder, however, that orders for rails are few when we are informed that those laid down from Ostend to Brussels, made to Mr. Sandberg's Goliath section of flange rail weighing 105 lb. a yard, have recently been accurately gauged after being in use for five years, and are calculated, at present rate of wear, to last a hundred years.

Effect of the Trolley on Watches.

A great many men are wondering what is the matter with their watches. Never since the town was a town have there been so many pocket timepieces taken in for repairs. The trouble lies in the trolley. The introduction of the electric wire for propulsion, making the car stop and go fast or slow, affects the average watch in a similar manner, and fortunate is the man who gets off a trolley with his watch in the same condition that it was before. He may catch a train or reach bank in time to pay a bill, but it will be by town clock time, not his own. Every watch thus affected has to be demagnetized.—*Philadelphia Times.*

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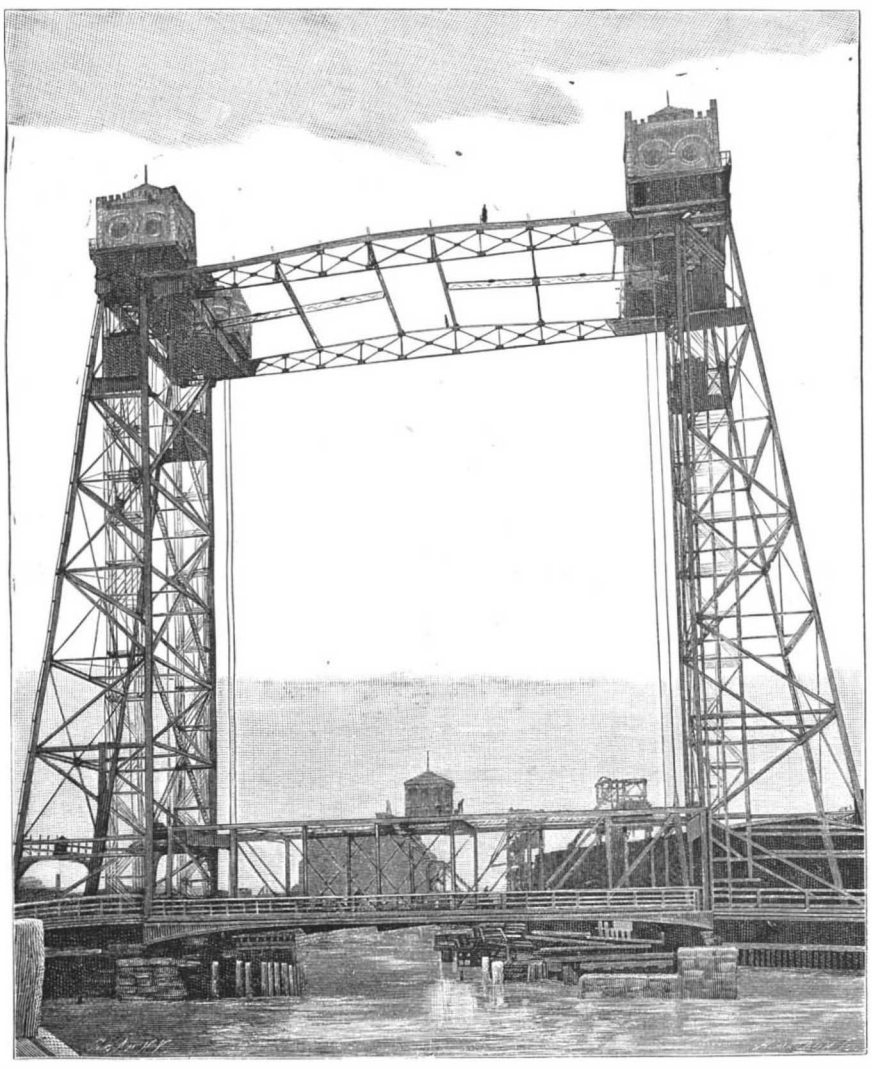
Water Taken from a Tree.

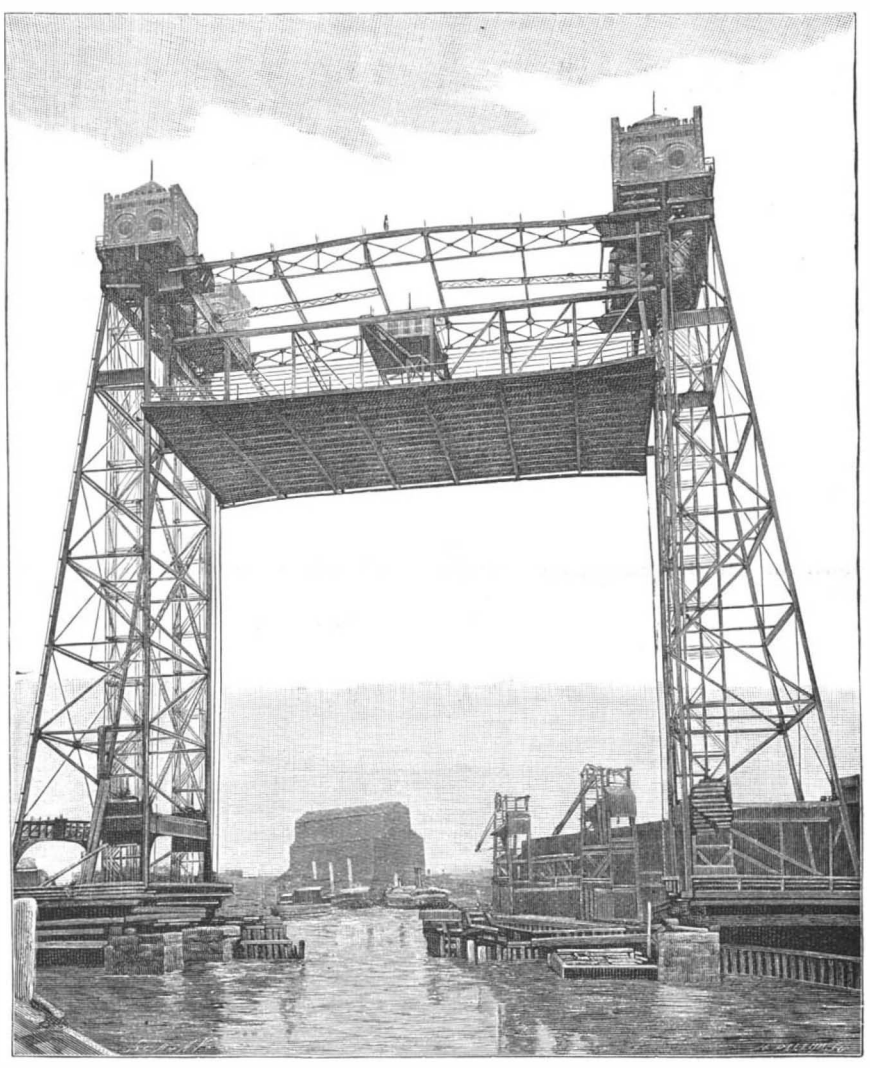
"There is a tree which grows in Madagascar called the 'Travelers' Tree,' which is of the greatest service to the tired and thirsty travelers in that tropical climate," said Professor Wilbur G. Stebbins, of Richmond, to a St. Louis *Globe-Democrat* reporter. "This wonderful tree has no branches, the leaves growing from the trunk and spreading out like the sections of a fan. These leaves, of which there are generally not more than twenty-four on each tree, are from six to eight feet in length and from four to six feet broad. At the base of each leaf is a kind of cup containing about a quart of cool, sweet water. The natives save themselves the trouble of climbing the tree by throwing a spear, which pierces the leaf at the spot where the water is stored. The water then flows down into the vessel held beneath it, and the traveler is enabled to continue his journey, cheered and refreshed by the precious liquid nature has so kindly provided for his use."

NEW LIFT BRIDGE, CHICAGO.

Our engravings illustrate the new lift bridge lately completed over the Chicago River at South Halsted Street. Owing to the refusal of the Secretary of War to allow the placing of a pier central in the river, the same being considered an unnecessary obstruction, it became necessary to erect either a drawbridge, or a two-leaved bridge, or a lift bridge. The two first-named forms were found, for various reasons, to be objectionable for the Halsted Street locality, and that of the lift bridge found favor and was adopted. The method of construction will be understood by a glance at our engravings, which are from photos. given in the *Graphic*. Frame towers are erected, one on each side of the river, between which the bridge proper is made to rise and fall by means of cables and counterbalancing weights. This form of bridge has several special advantages. The cost is comparatively low, the expense of operation is small.

The bridge itself is similar to the fixed bridge. It is continuous from end to end; is exceedingly stiff; any type of floor can be used on it, even granite blocks, if desired; and is more free from the danger of injury from collisions with boats. It is believed the merits of the design are such that this first bridge of this type will be produced in many similar localities.





CLOSED. NEW LIFT BRIDGE, SOUTH HALSTED STREET, CHICAGO. OPEN.

The Sunflower and its Uses.

BY NICOLAS PIKE.

This common but beautiful plant is familiar to everybody, and grows wild over our whole country. It will grow in almost any soil, and requires little in its cultivation. I shall endeavor to show in this article what a valuable plant it is, and what a profitable industry may be made by small farmers who have waste lands that could be profitably used for its cultivation at comparatively little expense. There are over fifty species of sunflowers known, but I shall refer more particularly to the giant flowered *Helianthus Annurus*. It is supposed to get its name from its head turning to the sun, from east to west, every day, hence its French name "Toures;" or, more probably, it is from its resemblance to the old pictures of the sun surrounded by golden rays.

In the year 1596 Girard notices the plant in England, and calls it flower of the sun, or "Marigold of Peru," as it has quite a respectable antiquity even in civilized countries. An acre of land will contain 25,000 plants, at 15 to 20 inches apart. It has been found that they will produce 80 to 100 bushels of seed, that will yield from seven to eight quarts of oil to the bushel. The refuse of the seeds, after the oil is expressed, can be made into oil cake for fattening animals. The stalks when burnt for alkali give 10 per cent potassa. As the sunflower exhausts the potash in the land to a great extent, the ashes would be valuable to return to the soil with manure. The green leaves make good fodder or can be used as ensilage. If dried and burnt to powder, they are good to mix with beans for milch cows. The seeds are said to be more oleaginous than those of the flax plant, and combine all the qualities of the best olive oil. It can be used for lamps and it burns as well as sperm oil, without its smoke. Painters say it is superior to linseed oil, as it dries rapidly and spreads easily.

The stalks are full of a strong fiber, like that of flax or hemp, which I shall speak of later. Machinery for all purposes has attained such excellence here, and much of it is so simplified and inexpensive, that machines for expressing the oil and separating the fiber can be procured at small cost. As the sunflower is less dependent on the weather than many plants, it is well worth trying by those who have waste lands, as the returns are quick and pretty sure.

There is another item where this plant can also be made most profitably available. Wherever a field of sunflowers is grown its owner should set up an apiary. It is one of the best bee pastures known. Its luscious and numerous nectaries yield an abundance of the best and most palatable honey. Any one who has passed near a clump of sunflowers in full bloom must have noticed what a buzzing the bees keep up round them, and what a strong scent of honey they exhale. I trust that this information may induce many to give this culture a fair trial, and that we may yet see fields of sunflowers as common as those of oats or rye.

Mr. Hargen, writing from Abilene, Kansas, says: The sunflower grows all over that State very luxuriantly, and that the great fields of these plants are seen through the summer, forming beautiful seas of gold when in bloom. They have been the bane of the farmer, as they take possession of every uncultivated field and wave their yellow medallions from the tops of eight and ten foot stalks for six months in the year. The difficulty has been to get rid of these stalks when clearing the field for spring crops, as it was thought they were useless. At last a use was found for them. The president of a paper mill in Salina had difficulty in procuring straw with which to make paper. He looked upon the acres of sunflowers that grace the bottom lands of the Smoky Hill River, and went to experimenting. With a flatiron and hammer he pounded up the stalks and decided that the pulp would do. He arranged at once for a trial of the stalks in lieu of straw at his mill, and the results surprised not only those who witnessed the experiments, but himself as well. The fiber proved to be better than that of straw and produced better paper, as the toughness enabled them to make a larger amount of paper from a given amount of pulp. The gummy substance that destroys so much paper at the press rolls is absent, and the sheets run through driers and finishing calenders without sticking or tearing. The entire stalk of the sunflower is used, and the small cost of the raw material, being merely that of gathering, promises to make a new manufacture profitable. The mill is now turning out the unique product steadily and others will soon take it up. Thus far only express and hardware papers are being manufactured regularly, though sufficient paper of a better quality was made to print the *Daily Republican*, of Salina, on the day of the trial, October 27, 1893. Kansas seems to be only just learning the extent of her resources.

The seed of the sunflower given to chickens in the winter answers as well as animal food for them, and helps to produce eggs early in the season when fresh ones are scarce, so profitable in every market. The young flower cups, when taken before the seeds are formed, and dressed like artichokes, are very palatable. One species, the *H. tuberosa*, a tall, wild plant, known as the Jerusalem artichoke, is also a useful plant when cultivated so as to increase the size of the tubers. They give a wholesome vegetable, and will prosper where potatoes fail and make a good substitute. Thus it will be seen that the sunflower is one of the most valuable crops the farmer can raise on his waste land, as it will grow where other crops fail.

Electrolysis of Water Pipes.

Corrosion of water pipes and other underground furniture by the ground return of electric railways continues to be observed. The recent annual report of the Brooklyn Electrical Subway Commission states that discoveries of corroded water and gas pipes have been of late so numerous that there seems no escape from the conclusion that metal pipes of all kinds extending below the surface along the routes of the trolley cars are being in many places destroyed by the ground currents. *Engineering News* says that at Peoria (Ill.) the water company have formally notified to the city authorities that their mains are being injured by the currents from the street railways; and unless these ground currents are removed, the company will refuse to further extend their mains, or be responsible for the maintenance of those now laid.

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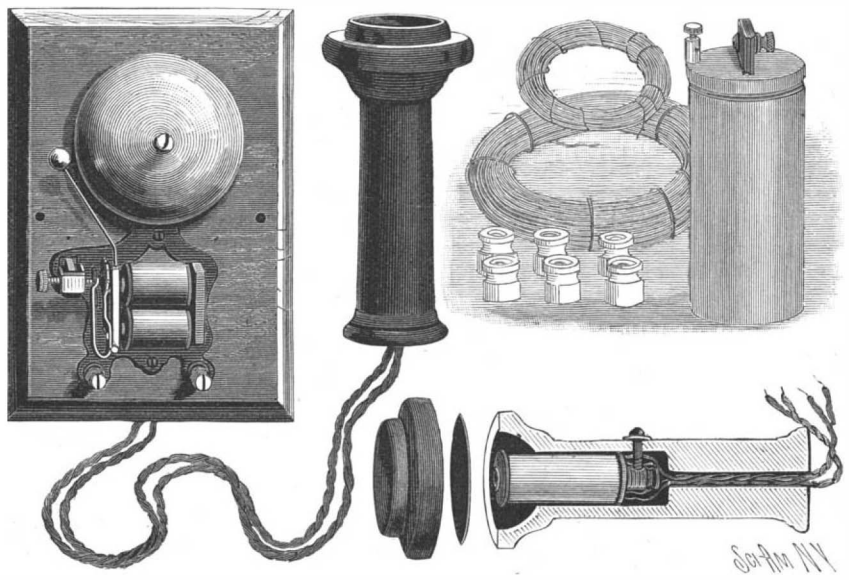
A SIMPLE AND CONVENIENT TELEPHONE.

The expense of rental of telephones has prevented many from making use of these almost indispensable instruments; and while the expiration of the Bell patent throws the way open for competition in a certain way, it has made little or no difference in the rentals. Under these circumstances, an enterprising firm in this city—Messrs. Robert H. Ingersoll & Bro., of 65 Cortlandt Street—have devised a compact, simple, and efficient telephone system, complete for both ends of the line, including two receiver-transmitters, two call bells, two batteries, line wire, annunciators, and insulators, as illustrated, which they sell for $5. This seems a wonderfully small price for the amount furnished.

The telephone is made to act as both transmitter and receiver. The battery, in connection with a bell especially made for this purpose, answers for signaling for any ordinary distauce. The outfit sold for $5 is guaranteed to work satisfactorily on lines of one-fourth mile and under. With additional batteries this distance may be increased. The makers furnish outfits for distances up to ten miles at proportionately low prices.

It is a very simple matter to set up this telephone in position for use. The baseboard is screwed to the wall or other support. Two wires at the bottom of the board are connected with the battery, and two at the top are attached to the line. A button at one side of the baseboard is pressed for giving the signal, and a similar button at the other side is pressed while the talking goes on. It will be observed that no induction coil or special switches are required forthis telephone. It is plain, simple, and well adapted for inside use and short lines, or for any use not necessitating any central office system.



AN INEXPENSIVE TELEPHONE OUTFIT.

MARINE STEAM DYNAMO.

We illustrate a combined steam engine dynamo, of which Messrs. E. Scott & Mountain, Limited, of the Close Works, Newcastle-on-Tyne, have just completed two sets for Sir W. G. Armstrong, Mitchell & Co., of Elswick, Newcastle, for the Chilean cruiser Blanco Enclada, two similar sets having previously been supplied for the Japanese cruiser Yoshino. We are indebted to *Engineering* for our illustration and the following particulars. The engines illustrated are of the compound type, with cylinders 8½ in. and 15½ in. in diameter by 8 in. stroke. Steam is admitted to the cylinders by means of a central valve worked by one eccentric from the crankshaft. The engines, as will be seen, are coupled direct to the dynamo, which is compound wound, of the Admiralty type, and capable of giving an output of 400 amperes at an electromotive force of 80 volts when running at a speed of about 300 revolutions per minute. This speed is attained with an initial steam pressure of 100 lb. per square inch in the cylinders. The bed plate is made in three pieces. The engine bed is of cast iron, the dynamo bed of gun metal, and the outer bed plate carrying the outer bearing is of cast iron. The object in making the bed in this way was to enable the machinery to be got readily into position and also to reduce weight, but in any case it would have been necessary to place brass blocks underneath the dynamo, and it was considered that by increasing these blocks to some extent, and forming them into a bed plate, a very satisfactory arrangement would be obtained, an opinion which has proved correct. To insure absolute steadiness and freedom from spring, two stays are fitted from the top of the magnets to the columns of the low pressure engine.

Inland Coast Waterways for Seaboard Defense.

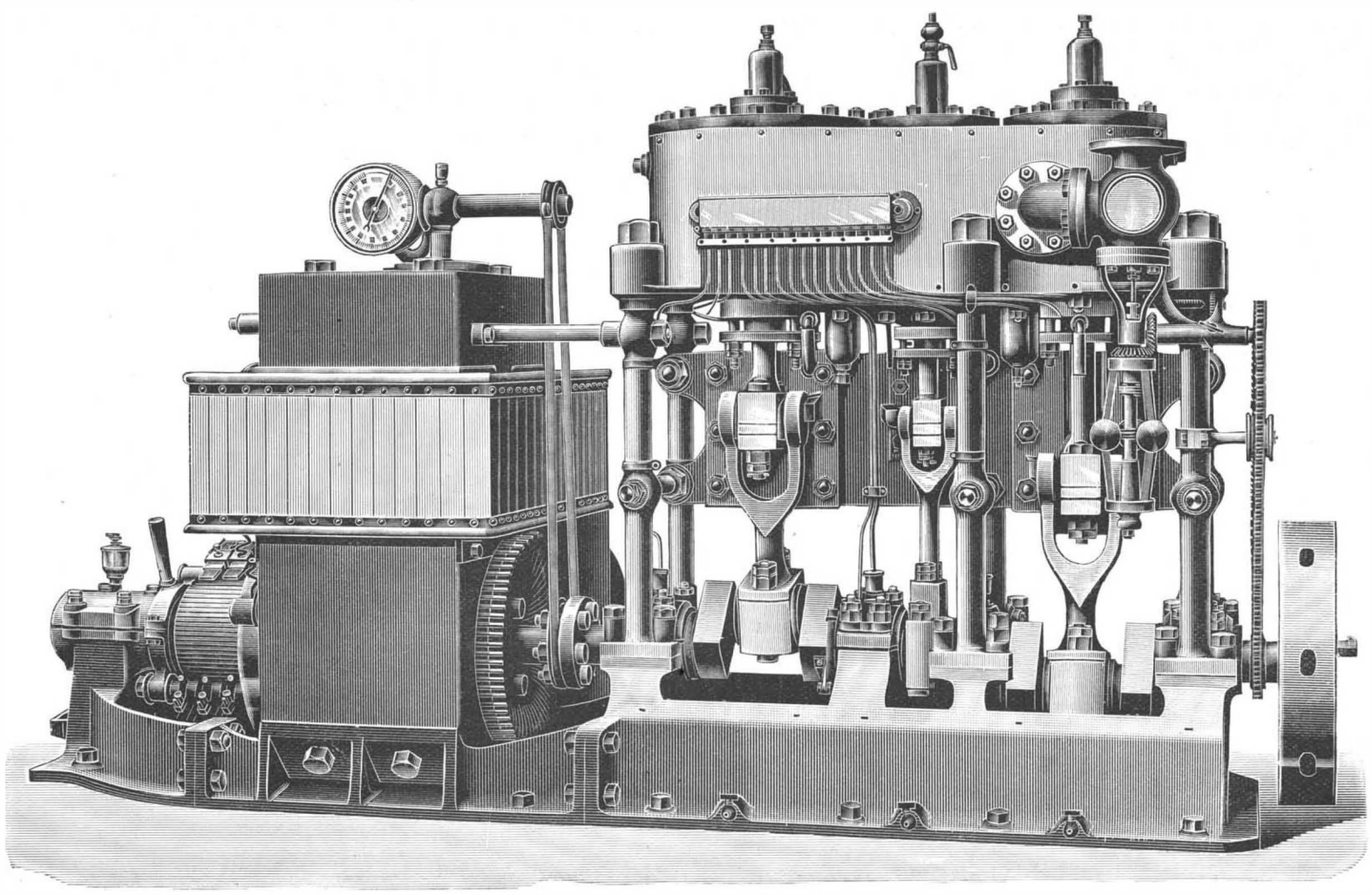
The advantages for seaboard defense afforded by the conformation of the coast line of the United States are very marked. The recent voyage of the torpedo boat Cushing from Washington to New York was made by inland coast waterways. The Cushing steamed down the Potomac to Chesapeake City and there passed through the canal, up the Delaware River, through the Delaware and Raritan Canal and Raritan River to New York Harbor. The vessel carried full weight. The trip of the Cushing demonstrated that with our present system of natural and artificial inland coast waterways we have the power of mobilizing small war vessels on inland waters. The French have made a thorough study of the concentration of torpedo boats and have facilities for transporting them by rail to any part of the coast.

Surveys have been made to test the feasibility of all water communication between Texas and Massachusetts. The northern section of the trip could be managed by cutting a canal through Cape Cod. The route would then be as follows: through Long Island Sound to New York, thence to Chesapeake Bay by the route taken by the Cushing. From Norfolk the trip could be continued by the Dismal Swamp and Drummond Lake to the waters of North Carolina. Between the Neuse and Cape Fear Rivers artificial communications would be required. Thence a bad break occurs, in which the vessels would have to take the ocean or else a very expensive construction would be necessary to furnish a protected waterway. The sounds and bays of South Carolina and Georgia would transport the boat to a canal cut through Florida. The bayous and lagoons of Florida, Alabama, etc., complete the route to Texas.

A Map Six Hundred Years Old.

On the wall of the south aisle of Hereford Cathedral, accessible to the visitor at all times, is preserved the celebrated "Mappa Mundi" (date *circa* 1282-1300). This is the work of an ecclesiastic, who is supposed to be represented in the right hand corner on horseback, attended by his page and greyhounds. He has commemorated himself under the name of Richard de Haldingham and Lafford in Lincolnshire. His real name was Richard de la Battayle or de Bello. He held a prebendal stall in Lincoln Cathedral, and was promoted to a stall in this cathedral in 1305, afterward becoming Archdeacon of Reading. During the troublous times of Cromwell the map was laid beneath the floor of Bishop Audley's Chapel, where it remained secreted for some time. In 1855 it was cleaned and repaired at the British Museum. This is allowed to be one of the most remarkable monuments of its kind in existence, being the largest and most interesting of all the old maps, drawn on a single sheet of stout vellum. The world is here represented as round, surrounded by the ocean. At the top of the map (the east) is represented Paradise, with its river and tree; also the eating of the forbidden fruit and the expulsion of our first parents. Above is a remarkable representation of the Day of Judgment, with the Virgin Mary interceding for the faithful, who are seen rising from their graves and being led within the walls of heaven. The map is chiefly filled with ideas taken from ancient historians. There are numerous figures of towns, animals, birds and fish, with grotesque creatures. The four great cities are made very prominent—Jerusalem, Babylon, Rome and Troy. In Great Britain most of the cathedrals are mentioned.—*Cathedrals, Abbeys and Churches.*

IN HALF A CENTURY.—A statistician has estimated that a man fifty years old has worked 6,500 days, has slept 6,000, has amused himself 4,000, has walked 12,000 miles, has been ill 500 days, has partaken of 36,000 meals, eaten 16,000 pounds of meat and 4,000 pounds of fish, eggs and vegetables, and drunk 7,000 gallons of fluid.



IMPROVED MARINE STEAM DYNAMO.

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PROTECTION OF PILES AGAINST THE TEREDO.

The February number of the *Transactions of the American Society of Civil Engineers* contains an interesting paper on this subject by R. Montfort, C.E., of the Louisville & Nashville Railroad Company, from which we make abstracts as follows:

The New Orleans division crosses a number of bays, bayous, and rivers, all of which are spanned by means of yellow pine creosoted pile trestles and iron bridges supported by creosoted pile piers.

The total number of linear feet of trestle is 21,407, and of iron bridging 6,459. It is no uncommon occurrence for the teredo to completely honeycomb an untreated yellow pine pile of from 12 to 15 inches diameter in less than six months, so as to render it unsafe for structural purposes. In 1871 a serious accident occurred from this cause at Biloxi Bay trestle, when a freight train went through the bridge, although the piles were only about ten months old. An examination showed that the piles were all eaten off close to the bottom of the water. When first built, Bay St. Louis trestle had hardly been completed when it was found the untreated piles were so badly attacked by the teredo that it was necessary to commence rebuilding at once. It 1872 resort was had to covering the piles with copper before driving, and this gave better results; but the protection was not found to be perfect. It was, therefore, decided in 1876 to construct creosote works, and they were built at a cost of $60,000.

In 1886 it was discovered the teredo had commenced its attacks on the creosoted piles. About the same time an inspection of the creosoted piles in the railroad company's wharves at Pensacola, Fla., which had been built in 1880, disclosed a similar condition of affairs.

In view of the vast amount of creosoted timber that existed in the structures on the New Orleans division, already referred to, and also at Pensacola, Fla., and on the Pensacola & Atlantic Railroad, which was built in 1882–83, and is owned by the Louisville & Nashville Railroad Company, the question of determining, if possible, on some further means of protecting the cresoted piles against the teredo was of vital importance. In connection with the late F. W. Vaughan, M. Am. Soc. C. E., consulting engineer, the writer was instructed to investigate, experiment, and report, with recommendations of what should be done. As a result, it was decided to adopt a thin coat of cement mortar or concrete, applied to the outside of the piles from the surface of the mud or sand at the bottom to the surface of high water at the top. In order to accomplish this, the work was conducted in the following manner: A shell of wrought iron, made in circular form, composed of several sections, each in two segments, so arranged as to be easily separated, was placed around the pile; the shell was clamped together above the water and lowered, one section after another, until it completely surrounded the pile from the surface of the water to a distance of from 6 inches to 2 feet below the bottom, varying with its hardness and the difficulty of forcing the shell down. A diver placed a pudding of "gumbo clay," inclosed in sacking, between the shell and the pile at the bottom before the shell was forced down, thus making the space between the pile and the shell almost watertight, where the depth of water did not exceed 12 feet; the water was then pumped out and the mortar or concrete poured in.

Where the depth of water exceeded 12 feet, it was found impracticable to keep the water out, and the attempt to do so was given up. In such case the mortar or concrete was passed down to the bottom of the shell through a galvanized iron pipe of special shape, so as to give as large an opening as possible without taking up too much space between the pile and the shell. A funnel or feeder was used at the top of the pipe to render it easy to fill. The pipe was gradually raised as the concrete filled up the space between the pile and shell; but the lower end of the pipe was kept constantly in the concrete, so as to prevent the concrete from falling through the water, which would separate its constituents, and, of course, ruin its adhesive power. The shell was allowed to remain three or four days, until the concrete had set, when the clamps were pulled off, and it was removed and placed on the next pile to be treated in a similar manner. Shells made of wood, held together with cast iron bands, were also used extensively on account of their relative cheapness as compared with the wrought iron shell. In this way 2,638 piles were protected in the wharves at Pensacola, 840 in Escambia Bay trestle, 413 in Biloxi Bay trestle, and 216 in Bay St. Louis trestle, making a total of 4,107 piles. It was only applied to piles that were found to be seriously attacked by the teredo, and that, if not protected, would soon be utterly destroyed. One important advantage which this means of protection possesses is that it can be accomplished without in any way disturbing the piles or the superstructure which rests on them, and this was especially important in the case of Pensacola wharves on which large storage sheds had been built. If the piles had to be replaced by new piles, the floors and roofs of these buildings would have greatly interfered.

It is now seven years since the work of protection, as described, was begun, and although some little trouble has been experienced from logs and rafts striking the protected piles in rough weather and abrading or cracking the concrete on a few of them, the expense of repairs has been small, and all of the piles which have been protected are still in use, and likely to continue so for a number of year; whereas, if they had not been protected, it would have long since become necessary to replace them by new piles. The engraving shows one of some piles broken off below the surface of the mud, and pulled up at Pensacola wharves three years after protection. They were found to be in good condition. Not only did the concrete completely cover the piles, and was itself covered with oysters, barnacles, etc., but the cement had found its way into the teredo holes, filling them even to the heart of the pile, and forming within it perfect casts of the teredo.

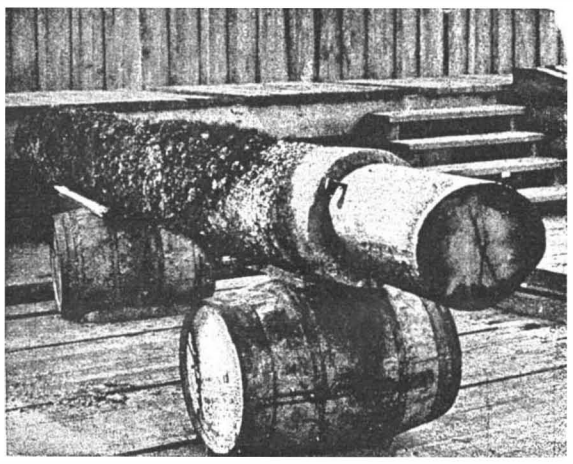
To remove the concrete required several heavy blows with an ax.

The piles were finally split up into small pieces, without finding a single living teredo.

The concrete was composed of sand, gravel, and "Alsen's" Portland cement, in the proportions of 1 of cement, 2 of sand, and 3 of gravel; sufficient water was used to render it thin enough to readily pass through the pipe. When the concrete was broken off, many of the fractures passed through the centers of the flinty gravel, showing the great strength with which the cement adhered.

The work of protection was first started at Pensacola, under the immediate charge of Superintendent E. O. Saltmarsh, to whom, as well as W. H. Courtenay, M. Am. Soc. C. E., Principal Assistant Engineer, a large part of the credit for the success of the undertaking belongs.

The cost of protecting piles in this way was found to vary from 80 cents per linear foot of concrete, measured



PENSACOLA WHARF—END VIEW OF PILE PROTECTED WITH CONCRETE, PILE REMOVED THREE YEARS AFTER PROTECTION.

on the pile, to $1.50 per linear foot, depending upon the length of the protection applied, the location of the pile, and the conditions of the weather; the average was about $1.25 per linear foot. But as the number of feet that required protection—viz., from high water mark to the surface of the bottom—was small compared with the total length of piles, the expense was much less than what it would have cost to have replaced the old piles with new creosoted piles.

Science Notes.

Artificial Whalebone.—Mr. Munck has invented a process for the manufacture of artificial whalebone that consists in first treating a raw hide with sulphide of sodium and then removing the hair. The hide is afterward immersed for twenty-four or thirty-six hours in a weak solution of double sulphate of potassa, and is then stretched upon a frame or table in order that it may not contract upon drying. The desiccation is allowed to proceed slowly in broad daylight, and the hide is then exposed to a temperature of from 50 to 60 degrees. The influence of the light, combined with the action of the double sulphate of potassa absorbed by the skin, renders the gelatin insoluble in water and prevents putrefaction, the moisture, moreover, being completely expelled.

Thus prepared, the skin is submitted to a strong pressure which gives it almost the hardness and elasticity of genuine whalebone. Before or after the desiccation, any color desired may be given it by means of a dye bath.

It can be rendered still further resistant to moisture by coating it with rubber, varnish, lac, or any other substance of the kind.

Calcium Carbide and Boride.—Mr. H. Moissan has recently obtained a crystalline compound of carbon and calcium, by employing the intense heat of his electric furnace, the temperature in which may approach 3,500° C. The crystals of this new body are described as reddish brown, opaque, and shining. They decompose in contact with water at the ordinary temperature into absolutely pure acetylene and oxide of calcium. The carbide, thrown into water, saturated with chlorine, disengages acetylene gas, which burns in contact with the excess of chlorine. It is attacked too by bromine, iodine and the vapor of sulphur. Hydrogen has no effect upon the new compound, nor has nitrogen. Iron and antimony are the only two metals found to react with the carbide. The most curious reaction, however, in which the new compound takes part is that which occurs when water is added to it. Pure acetylene is given off as soon as contact takes place, and the gas continues to be evolved until all the carbide is decomposed.

Mr. Moissan thinks that it is probable that in the first geological periods the carbon of the vegetable kingdom existed in the form of carbides. The great quantity of calcium distributed over the surface of the earth, its diffusion in all the deposits of recent or ancient formation, and the ease with which its carbide is decomposed in water may permit it to be believed that it has played a part in this immobilization of the carbon, under the form of a metallic compound.

Mr. Moissan has also, by means of his electric furnace, prepared carbon boride (first obtained by Joly) in sufficient quantity to permit of an examination of its properties. The compound, which forms brilliant black crystals of the density 2·51, is said to be very stable and extremely hard. In the latter respect it even exceeds the carbon silicide which is now offered in commerce as "carborundum," since the powder obtained by crushing it has proved to be capable of replacing diamond dust in the process of cutting diamonds. This is believed to be the first instance of a definite compound body being sufficiently hard to cut the diamond.

An Alloy of Gold and Aluminum.—During a series of experiments for the Royal Society's committee on researches upon alloys, Captain Hunt has made a discovery that will probably be utilized in the coinage of money. His alloy consists of 78 parts of gold to 22 of aluminum. These proportions, moreover, are the only ones in which these two metals alloy perfectly.

The product, it is said, is of a beautiful purple color, with ruby reflections, and cannot be imitated. Besides, as gold is 7·7 times heavier than aluminum, the same weight of the latter will be 7·7 times greater in bulk than the former.

Barometer of Great Sensitiveness.—The *Rivista Scientifica Industriale* gives the following description of a new barometer of extreme sensitiveness for use in coal mines. It consists of a vertical tube 20 millimeters in diameter internally, and about a meter in length, curved in the usual manner at the bottom. The free extremity is closed by a steel plug screwed into an iron collar fixed to the tube. Finally, a long capillary tube a millimeter in diameter is placed at right angles upon the large tube a short distance above the curved part, and terminates in an open receptacle.

The quantity of mercury is so regulated that the meniscus shall present itself toward the center of the capillary tube. The slightest variation in atmospheric pressure causes the mercury to rise and act upon the capillary column, in which the variations are augmented in the ratio of the sections of the tubes, that is to say, of 1 to 400, which permits of the reading of differences of one four-hundredth. When the changes of pressure become great enough to carry the meniscus outside of the capillary tube, the matter is remedied by acting upon the steel plug.

Internal Temperature of Trees.—The results of some experiments that Mr. W. Pring has been carrying on for the last nineteen years at Brussels present some interesting facts. These experiments demonstrate that the sap of trees contains quite a large quantity of gas, which escapes with a noise that is sometimes very marked and recalls the fizzing of freshly drawn aerated water. It takes place only toward the center of the line of the canal. The annual mean of the internal temperature of a tree is sensibly equal to the annual mean of the temperature of the air, but the monthly mean often varies from two to three degrees.

As a general thing it requires a day for a thermic fluctuation to be transmitted to the heart of a tree. On certain days, the difference between the internal temperature of a tree and that of the air may vary by 10 degrees, but ordinarily it is merely a few degrees. When the temperature of the air descends below zero, and continues to decrease, the internal temperature of the tree descends to a degree bordering on the point at which the water of vegetation freezes and remains stationary thereat. The water of vegetation freezes at a few tenths of a degree below zero. The absolute maximum of the internal temperature of a tree trunk may occur long before the absolute maximum of the surrounding air, because of the direct action of the spring sun and the air upon the leafless tree. During intense heat, in the course of the summer, the internal temperature of trees remains at about 15 degrees, with a variation of 3 degrees, at the most, even when the thermic variations of the air are exceptional. During ordinary years, a large tree is, on an average, warmer than the air in the cold months, and a little colder than the air in the hot ones.

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SIMPLIFIED APPARATUS FOR PHOTOMICROGRAPHY.

Every one knows at present the importance of the discoveries due to the use of the microscope, and upon this point it is absolutely useless to dwell. It appears to us preferable to recall that microscopic studies may find in photography a wonderful auxiliary, which permits of indelibly fixing the subject studied. Without dwelling more than is reasonable upon certain preparations that are apt to alter, as frequently happens with histological sections, photography will fulfill the role of an impartial and faithful observer, and give prints capable of being studied and discussed with fruit. In fact, they may be submitted to different observers, and be compared and verified. The same is evidently not the case when a discussion arises apropos of observations that have for obligatory intermediary the more or less faithful memory of the micrographer, or that are accompanied with drawings or sketches difficult to interpret. Unfortunately, photomicrography requires the use of complicated and costly apparatus. Without stopping at special apparatus, it will be necessary to own an excellent microscope, and combine the use of it with that of a camera constructed with a view to this particular application. And even in this combination, which is the simplest and most employed by all those who already own a microscope, we are yet at a standstill in certain hypotheses, because the microscope constructed for direct observation is not always adapted for photographic reproduction. Thus, with the ordinary microscope tubes, it is almost impossible to photograph wide preparations, such as the medullæ, which are so interesting to study in nervous pathology. As for the bulbs, they cannot be thought of. In such particular cases it will, therefore, be necessary to return to the models especially constructed for the use of photography. This rapid *exposé* of the difficulties that are met with in the practice of photomicrography easily explains why so few persons outside of scientific laboratories devote themselves to these researches, which are nevertheless so attractive.

Numbers of amateurs in photography would not be afraid to undertake such studies, new to them, if they could find a simple and inexpensive apparatus and utilize it with the material that they are accustomed to employ. It was such a thought that guided Mr. Lemardeley, a most distinguished young optician, in the construction of a small simplified photomicrographic apparatus that we are happy to make known to our colleagues, for in our opinion it completely solves the problem, and is bound to open up new horizons to such amateurs as are desirous of stepping ouside of beaten footpaths. We believe likewise that it will render service to many investigators who have not the means to spend large sums, and who with this apparatus will be able to pursue their special studies and obtain excellent results.

The apparatus is represented in Fig. 1. It consists of a piece, P, mounted upon pillars and provided with two clips, V V. At O is seen the objective provided with a micrometer movement, M. C is a condenser. At D is the diaphragm designed to limit the field of the image. The whole is fixed to a disk, R, analogous to that of photographic objectives, and which it suffices to mount upon the camera in order to be able to operate (Fig. 2).

Upon the whole, we find here all the parts of an ordinary microscope, less the illuminating mirror and the tube that carries the eye piece.

The suppression of the microscope tube is important, for that is what permits of obtaining the essentially practical arrangement of the Lemardeley apparatus, which is adaptable to any camera, like an ordinary objective. In this way are likewise avoided the reflections that occur in the tube of the objective, and that it was formerly difficult to eliminate. Finally, there is no longer anything to prevent the reproduction of preparations with wide surfaces, and which it is impossible to effect with the narrow tube usually employed. The apparatus is illuminated by the direct rays coming from any luminous source placed in front on a level with the condenser, and at a short distance from the latter.

Naturally, the more intense the light, the more the image will be illuminated and the easier it will be to effect the focusing, and the more, too, will the time of exposure be reduced. In the experiments made by us, we employed the oxyhydrogen light projected upon a pearl of magnesia. Under such conditions, the time of exposure never exceeded a few seconds. But one can operate practically with an Auer burner or a good kerosene lamp. The condenser calculated by Mr. Lemardeley consists of a system of lenses so colored as to render the light monochromatic and to thus allow of a good definition being obtained. This system can be removed, and we then have a diaphragm of very wide aperture permitting of the reproduction of preparations with wide surfaces. The pillar piece, P, is arranged in a peculiar way. It is very widely hollowed out and the clips designed to hold the preparation are below instead of being above, as in all microscopes. This simple change from a practical view point has a genuine importance, since it permits of putting the preparation in a plane that is always the same, whatever be the thickness of the object holder or object cover.

In fact, in putting in place the preparation with the object cover on the side toward the objective, the latter locates itself in the opening of the pillar piece, and it will be the upper surface of the object holder that will always come in contact with the lower part of the said piece.

The optical system likewise studied by the inventor consists of a series of lenses calculated for giving various magnifications. In the apparatus that we have had in hand, the relation of the magnifying power of the various combinations was: First combination, 5 diameters; second, 20 diameters; third, 50 diameters. We speak here, of course, only of the proper power of each combination, and not of the size of the image, which varies, according to the extension of the camera, between five and several hundred diameters. The system of mounting of the objectiveis interesting to note, for Mr. Lemardeley, in order to render his invention still more practical, has devised a system of automatic focusing, which, it must be admitted, will greatly facilitate the operations for all those who are not familiar with the use of the microscope.

The tube of the objective holder, X, slides in a tube, Z, actuated by the micrometer screw. This tube is provided with two indents, E E′, of different depths. Upon placing the pin, G, of the objective holder tube in one or the other of these indents, or in contact with the edge of the tube, Z, the objective is placed automatically at such a distance that the image shall be distinct upon the photographic plate with every magnification. By this arrangement, feeling one's way is avoided, and the micrometer screw will be employed only for finishing the focusing, if that be necessary—a maneuver that will be useless if the apparatus is well regulated, and for the same extension of the camera, of course. If a short focus be employed, the pin must be put into the deeper notch in order to approach the front side of the preparation. In cases where the other combinations of longer foci are employed, the pin must be put into the indent of less depth, and, finally, against the tube, Z, for feebler magnifications.

As will be seen from the above description, Mr. Lemardeley's apparatus is remarkable by reason of its simplicity of execution and operation, and we are convinced that these qualities will assure it a genuine success.—*La Nature.*

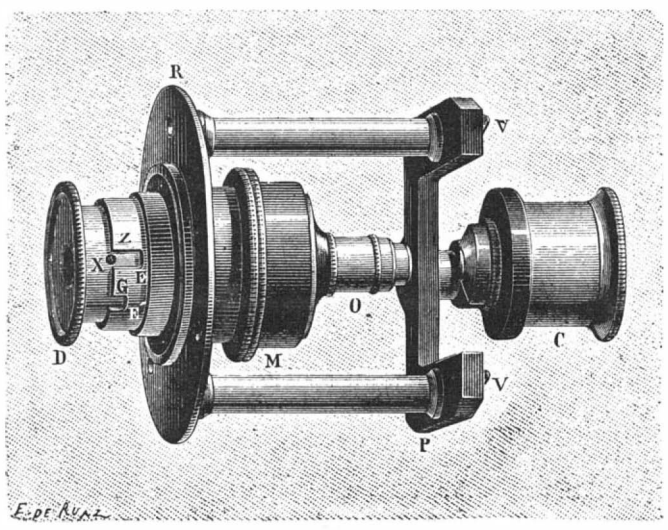

Fig. 1.—THE LEMARDELEY PHOTOGRAPHIC MICROSCOPE.

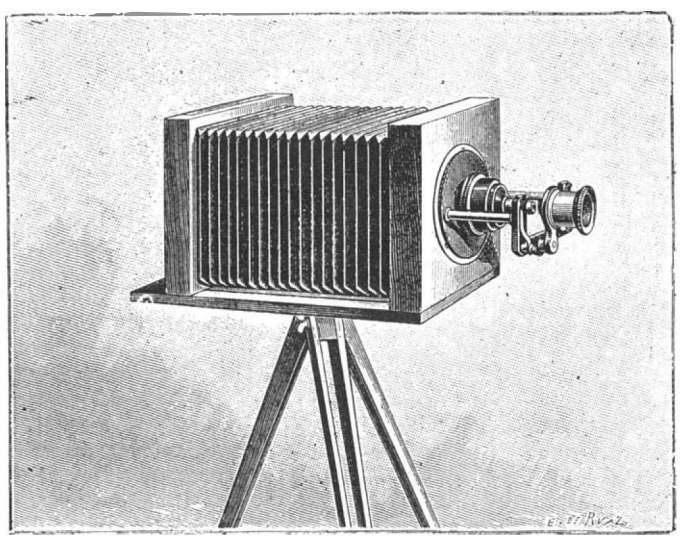

Fig. 2.—THE MICROSCOPE MOUNTED UPON A CAMERA.

THE *Engineering and Mining Journal* estimates the silver production of the United States last year at 60,000,000 ounces, as against 65,000,000 ounces in 1892.

Ophthalmic Surgery.

The Greeks held a knowledge of diseases of the eye to be an indispensable part of a medical education, and the accuracy of their descriptions in many cases attests the progress they made in this department. Not a few of the terms they employed are used to-day.

The ancient Egyptians also were celebrated for their skill in the treatment of the disorders of this organ. But this, like other branches of learning, sank into obscurity, and there remained till the eighteenth century, when its revival began with an operation for artificial pupil, giving sight to a boy blind from birth. This was soon followed by Daviel's operation for the cure of blindness due to cataract. This specialty now began to receive the attention of educated physicians, and in 1773 Barthe founded the Vienna school so celebrated at the present day. In 1804 the London Eye Infirmary was organized, and in 1822 the New York Eye Infirmary, soon followed by similar institutions in Boston and Philadelphia.

The opening of these hospitals gave a very considerable impetus to the study of diseases of the eye. But it was not until after the invention of the ophthalmoscope that great progress was made.

Many earnest workers now entered this field, in both the old world and the new, and the consequent advancement during the last fifty years has been unsurpassed in any other department of our art. Among these investigators were many whose achievements have laid the world under obligations of priceless worth; but I shall detain you to speak of only one—a name blazing with the splendor of a succession of triumphs more brilliant than those of field or forum. Von Graefe, who at the early age of forty-one fell a victim to unremitting toil in the service of this branch of our art, was justly regarded as one of the greatest minds in the profession. Among the many additions to our knowledge which we owe to him are two which alone would render his name immortal. Before his time thousands annually became blind from a disease often attended with agonizing pain and for which there was no cure known until he found it in the operation of iridectomy. In the method of cataract extraction for the cure of blindness due to this cause in vogue prior to his time, about twenty per cent of all eyes operated on were lost. This high percentage of bad results he so far reduced that in 1,000 cases operated on according to his method in the closing years of his life, his losses were less than three per cent, and this highly satisfactory result we now ordinarily obtain in our cataract operations.—*A. G. Sinclair, M.D.*

Nitrogen from the Air.

According to the *Evening Post*, of this city, machinery is now being set up in Newark, New Jersey, for manufacturing ammonia from atmospheric nitrogen. Every farmer knows that nitrogen is one of the essential elements of plant food and that it is far the most expensive of the elements that are required in fertilizing mixtures. It is well known, too, that nearly four-fifths of the great ocean of air that surrounds the earth is nitrogen, and that it is practically useless as food to plants, although they are bathed in it all the time. Recent researches have shown, it is true, that a small portion of this nitrogen can be utilized by certain plants, especially those belonging to the Leguminosæ, but there never has been any available method of transforming the nitrogen of the air into plant food for general use. Of course, it is not wise to expect too much from any reported discovery, but if it is true that the sulphate of ammonia can be produced by this new process at about one-quarter of its present cost, this will be one of the greatest boons that the science of chemistry has yet bestowed upon the art of agriculture. If ammonia can be cheaply manufactured from atmospheric nitrogen, the discovery means that a great step has been taken toward securing a material increase in the productiveness of the soil.

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Experiments in the Prevention of Potato Disease.

Experiments in the prevention of potato disease were made at the Albert Farm, Glasnevin, and at Garryhill, County Carlow, in 1892.

According to the recently published report of the Agricultural Department, the Flounder, a variety extremely liable to disease, was selected, and the experiments were made with a view to ascertain whether the mycelium of the fungus reached the tubers through the tissues of the plant or by means of the spores falling upon the earth and then washed down to the surface of the tubers in the soil. The ground was covered early in June beneath the plants with cotton wool, carefully placed round the stems, with the object of filtering out the spores that might fall upon the ground. The disease appeared in July and the leaves of the plants were badly affected. When the potatoes were lifted in October it was found that there were no diseased tubers beneath the cotton wool, but a considerable amount of disease in the unprotected ground. Hence, it is provisionally inferred by those in charge of the experiments that disease spores reach the tubers by passing through the soil, but further experiments are necessary before stating definite conclusions. If this point be established, the advantage of high moulding, as advocated by Mr. Jensen, in providing a layer of earth of sufficient thickness to filter the rain water as it descends through the earth, and thereby arrest the spores before they could reach the tubers, will receive further proof. The potato crops in County Dublin are generally more free from disease than those grown in other parts of Ireland. This comparative immunity is attributed to the earlier planting of the crop, keeping the land free from weeds, and the general system of changing the seed from which the crop is grown year by year.

Cedar for Pencils.

Ask the next wise man you meet how many lead pencils are consumed per capita by the inhabitants of the United States and see if his wisdom will stand by him. If he answers correctly, says the *Northwestern Lumberman*, he will say something less than four for every man, woman and child.

The wood of which these pencils are made comes from Florida. It is red cedar, straight grained and comparatively free from knots. One of the manufacturing concerns has a mill in Florida where cedar logs are transformed into strips about seven inches long, three-eighths of an inch thick and three inches wide. These strips are crated and sent North. Each strip represents a half of six pencils. Six grooves are made lengthwise; into these grooves the graphite is placed and two strips are glued together. The block is then split into squares and the pencils finished either round or hexagon as desired.

May be you have never thought of it in that light, but the pencil industry uses up a large amount of cedar. An average red cedar log contains about four cubic feet of wood, and there are on an average 25 trees to the acre. If no mistake has been made in the rapid computation, it requires the timber from not less than 2,600 acres to supply the pencil manufacturers of this country. In addition considerable cedar is exported to Germany. Alabama was once the great pencil cedar producing State, but the cedar, which was clearer and larger than that found in Florida, is exhausted. Manufacturers have tested other kinds of wood with a view to finding a substitute for cedar, but so far without success.

It doesn't take long to make one pencil. The graphite is ground and mixed with great care, and in this mixing is the pencil maker's secret. The mixture is placed in a machine that might properly be called a little sausage stuffer, from the end of which is forced a constant stream of lead the proper size for a pencil. These threads of lead are cut in lengths, baked in an oven, and when hard are glued into the little grooves. The rough pencils are shaped either round or hexagon at the rate of 75 a minute, or 45,000 a day; 125 pencils a minute, or 75,000 a day, are colored and varnished; burnishing and stamping are done at the rate of 100 a minute, or 60,000 a day. This work is done by machinery operated by girls not more than 12 years of age, and who, no doubt, earn as much as a dollar or two a week.

The little blocks which are frequently used inside of the bunches of pencils are made of poplar, each block being grooved to fit the pencils. Twenty years ago you paid more for a pencil than you do to-day. The invention of machinery and the discovery of a graphite mine have reduced the cost of them at least 50 per cent. Foreign pencils have been gradually ousted, and at present, if I am not mistaken, we export about as many lead pencils as we import.

The few factories in this country hang together like brothers, and the chances are that if we should put our spare money into a lead pencil factory, they would make it warm for us. Whether you think a pencil is a good one or not, depends. If the profits on lumber are rolling in and you are making money hand over fist, you would be satisfied to figure with a burnt stick, but when it is uphill business to make the two ends meet, it takes an A 1 pencil to call out favorable comment.

Creameries and Typhoid Fever.

Another very important case has occurred in Ireland, in which it is alleged that the poison of typhoid fever has been distributed through the agency of a creamery. It seems that there is at present a serious outbreak of enteric fever in and around Castleisland, and that a local creamery had received milk from farms on which the disease existed, had separated the cream and then distributed the "skim" in proper proportion among the different farms. No proof was offered that this was the cause of the epidemic; the charge brought against the creamery being that, "being purveyors of milk or occupiers of a milk store," they had allowed the milk to be handled by a person in contact with one suffering from a dangerous infectious disorder. A penalty of £5 was imposed. The recent enormous extension of the creamery business, involving as it does the mixing of the milk from whole districts, evidently brings with it many dangers.

Formerly milk typhoid was characterized by sudden outbreaks widely spread among the customers of infected farms; but under the creamery system, by which each farmer receives back his proper proportion of skim from the general stock, enteric fever on any one farm tends to be rapidly distributed throughout the dairies served by the creamery, and it becomes quite obvious that, if the creamery system is to be safely worked, a very careful and thorough system of inspection of the farms must go along with it.—*British Medical Journal.*

Unknown Dead in a Great City.

Albert H. White, keeper of the morgue in this city, testified in a murder trial the other day that 140,000 bodies have passed through his hands since he has been the keeper. He added that he knew many cases where mistakes had been made as to the identity of dead bodies, and cited the case of a woman who claimed a body as that of her husband and had the body buried in Calvary Cemetery.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

AUTOMATIC GRAVITY CAR COUPLER.—A. R. Heath, Covington, Ind. According to this invention a pendant pointed hook on the drawbar through a slotted hole in the front end of the draught timbers and front ends of clevis, hooks to the bar in the opposing car, there being lift handles at either side of the car, or handles having a link connection at the top of the car. The drawbar is attached to rear springs in all cars. An old style link may be employed to couple with other couplers. There is a spring buffer in the deadwood and sill above, so that the hook pin or drawbar never buff, and the draught timbers and irons never buff out, and there is no occasion for trainmen to go between the cars. The engineer in his cab may operate the device to uncouple cars from the train. The coupling is simple, durable, and inexpensive.

RAILROAD FROG.—David Horrie, Kaukauna, Wis. This is an improvement in which the rails are utilized to produce the frog, in a combination of supported converged track rails and swinging rails bent near one end to approach each other, their shorter portions aligning with the track rails, between which and the adjacent ends of the swinging rails is secured a wedge-shaped filling block, having diverged limbs lying along the inner sides of the swinging rails, there being an intermediate frog point with apex introduced between the parts of the swinging rails. The construction is simple and durable, and adapted for the traverse of rolling stock in either direction of travel, facilitating also the safe crossing of one track over another track.

Electrical.

STORAGE BATTERY PLATE.—Chaimsonovitz P. Elieson, London, Eng. This invention relates to plates or non-tubular electrodes of the Plante type, and the battery plate is built up of parallel layers of corrugated and perforated metal, the corrugations of one metal being at an angle to those of the adjacent layer, so as to prevent nesting or coinciding, and preserve an even and constant groove space between and a fixed and permanent bracing of the layers in relation to each other, the plates so built up having their corrugations parallel to the plane of the plate, and having also detached vertical terminal edges. The buckling and consequent rapid disintegration of the plates is thus prevented, and uniformity of internal construction and resistance is insured.

Mechanical.

PLUMB RULE.—Frank Holt, South Pittsburg, Tenn. This is a rule having two graduated blades arranged at right angles, with their edges parallel to one another, and adapted to fit on and be secured to the corner of a wall. It is of simple construction, and more especially designed for the use of masons and bricklayers, enabling a workman to quickly and accurately lay the stones or bricks in proper position, according to the measurement indicated on the members of the rule.

TRACE CUTTING AND TRIMMING MACHINE.—Henry A. Dodge, Boston, and William T. Richards, Newton, Mass. This machine is adjustable to form traces of any desired width, and the knives are automatically operated upon the leather to simultaneously trim the side faces and round off the upper and lower corners, a trace of perfect construction being formed by simply passing the material through the machine. A wheel carrier automatically feeds the trace leather or strap to the knives, which are upon carriages at each side of the strap, and automatically adjust themselves to any desired thickness of strap.

STONE AND ORE CRUSHER.—Caleb G. Collins, Woodsburg, N. Y. This machine has revoluble rings in peripheral contact with each other, crushing rolls in interior frictional contact with the rings, and at points in alignment with the peripheral contact point of the rings, rocker arms carrying the shafts for the crushing rolls, and guide rolls carrying the rings. The machine is designed to reduce to a pulverized state stones, ores, and other hard and refractory substances, the machine being of large capacity, and operated at a minimum loss of power through friction.

Agricultural.

THRASHING MACHINE.—Alexander M. Lockhart, Mitchell, South Dakota. This machine is designed to be very effective in operation, and to completely separate the grain from the chaff. It has an elevator for raising the chaff into a conveyor, discharging into a fanning mill, which delivers the heavy chaff into a conveyor connected with a second elevator discharging into a return spout for carrying the chaff back to the thrasher cylinder.

Miscellaneous.

OVERHEAD CABLE TRACTION.—Walter G. Berg, New York City. This system is for propelling vehicles traveling on the ground or on tracks, but not for supporting their weight. It comprises an overhead fixed track on which travel wheeled hangers connected with an endless traveling cable, which has a flexible connection with a vehicle traveling on the ground or on a track, one part of the connection being secured to the vehicle and the other to the cable, the two parts being detachably connected. The improvement is principally designed for propelling cars and other vehicles in warehouses, mines, on wharves, etc., for transporting persons or merchandise.

ADJUSTABLE ODOMETER.—Theodor Schroeder, New Prague, Minn. This is an instrument to be attached to carriages, for the use of livery keepers, and for surveyors and civil engineers, to indicate the number of miles traveled. It is designed for application to the wheels of all vehicles, irrespective of their size, and still afford an exact measurement record, being adjustable to the size of the wheel, computing its circumference in feet and fractions thereof, and at each revolution transferring such measurement to different gears to be recorded in a cumulative way upon the register of the odometer in miles.

HEATER.—Joseph H. Adams, New York City. To properly heat and ventilate rooms, halls, shops, cellars, etc., where ordinary sources of heat are not practical or convenient, is the design of this invention, which comprises an exterior shell with air inlets at its lower end and outlets at the upper end, a central smoke pipe connecting with the source of heat having near its middle a damper or valve, while a series of smoke flues arranged in the shell are connected at their lower and upper ends with the smoke pipe to cause the heat and smoke to circulate through the flues, to heat the air circulating in the shell around the flues.

RACKING BEER.—August Werner, Brooklyn, N. Y. For the filling of beer, ale, and like liquids, from casks into kegs or other vessels, this inventor has devised a method and apparatus according to which the liquid is discharged from the storage cask to an elevated receiver, subjecting the receiver to gas pressure, passing gas into the vessel to be filled and discharging air therefrom, and then passing in the liquor charged with gas. The receiver is adapted to be raised and lowered, the beer preferably being filtered before being passed into it, and the pipe of the filling device having a liquid controlling valve, while a gas valve is connected with the gas supply for regulating the egress of the air from the keg and holding the gas in the keg while filling it with the liquid.

LUBRICATOR.—William A. Seibel, Independence, Iowa. According to this invention the machinery to be lubricated has movable projections and a bracket carrying a pulley, while the oil can has a spring-pressed slide valve and an arm engaging the projections, a lifting rope from the can passing over the pulley, and a guide rope depending from the side of the can. The improvement is more especially designed to facilitate the lubricating of elevated machinery, such as windmills, the operation being effected from the ground and obviating the dangers incident to climbing the framework or towers.

METAL FENCE.—George D. Hamilton, Innisfail, Canada. This fence has tapered, tubular metallic posts, with keyhole slots, and hollow metallic rails with concave ends whose side portions or ears are perforated, the fastening bolts being inserted through the posts in the slots, while flanged pickets are bolted to flanges on the rails. The fence is cheap, substantial, easily constructed, and may be made very ornamental.

TRUNK.—Benjamin Dickenson, New York City. This invention relates particularly to trunks having removable drawers, and provides a construction which facilitates the taking out of the drawers, but with an automatic fastening device arranged inside, so that it cannot be tampered with and is not exposed in any way to be broken, but which is automatically operated by the opening and closing of the trunk lid, the closing of the lid locking the drawers and the opening of the lid releasing them.

COMPOSITE BOTTLE.—Alphons Dryfoos, New York City. In the sides of this bottle are vertical niches or recesses in which are set small bottles of special construction, for holding a variety of liquids, the arrangement being such as to permit of pouring the liquid either singly from any of the individual bottles, or from two or more at the same time, for making a mixed drink.

FAN.—Max Rubin, New York City. This is a folding or pocket fan in which retaining arms are secured to the folding body and adapted to fold with it, receiving arms being connected with one another and with the retaining arms. The fan presents a very neat appearance, is readily opened for use, and occupies but little space when folded.

MIXER OR BEATER.—Arobine C. Mitchell, Ennis, Montana. This device is more especially designed for use on the materials or batter of which cake, etc., are made, the invention being an improvement on a former patented invention of the same inventor, and providing means for increasing or decreasing the speed, and whereby the basin may be more readily removed from the frame, also providing a bearing for the piston of the beater that it may be operated with least friction, the cost of manufacture being likewise reduced.

DESIGN FOR VASE SUPPORT.—Albert Wanner, Jr., Hoboken, N. J. This is an ornamental support for vases and other receptacles, in which continuous leaf-like effects in wreath form are shaped to project upwardly crisps and tendrils to join a ring-like margin at the top of the base.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

AMERICAN PLUMBING. A complete compendium of practical plumbing, from solder making to high class open work. By Alfred Revill. New York: Excelsior Publishing House. Pp. 224. Price $2.

The present work is written from the standpoint of the city of New York, and furnishes an excellent example of the improved metropolitan practice. Especially to be commended is its reference to the laws of the Health Department of the city of New York. This is something which will make it of use to other communities as a model of practice.

ESSAYS IN HISTORICAL CHEMISTRY. By T. E. Thorpe. London and New York: Macmillan & Co. 1894. Pp. 381. Price $2.25. No index.

So much has been written about theoretical chemistry, and experiments in it, that the appearance of a systematic work on its history from the days of Boyle to the era of Mendeleef, the latter representing the most advanced views of the present time, is particularly to be welcomed. Professor Thorpe's high qualifications for this work need no comment from us. The book absolutely fills what has been a decided want, and it should form part of every true chemical library. We cannot let it pass without paying due tribute to its excellence, but the work would be of many times greater value if it had been provided

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with an index. We have seen few books in which the absence of this feature is more to be regretted.

CAMBRIDGE NATURAL SCIENCE MANUALS. Physical series. Light. An elementary text book, theoretical and practical, for colleges and schools. By R. T. Glazebrook. Cambridge: University Press. 1894. Pp. 213. Price $1.

This little work claims to embody the teaching of the physics of light by experiment. This, however, does not prevent it from presenting a very valuable treatment of the subject, in which the laws of light are well stated, and the use of simple experiments and not their abuse is given. It is designed for medical students at the Cavendish laboratory, but this really operates as a very minor restriction on its scope.

TELEPHONE LINES AND THEIR PROPERTIES. By William J. Hopkins. New edition, revised and enlarged. New York: Longmans, Green & Co. 1894. Pp. xvi, 268. Price $1.50.

The production of a adequate work on the subject of telephones, more especially on the lines and circuits, seems really to have filled a want existing in technical literature. We are convinced that in its practical details, as well as its examination of induction and the properties of telephone lines, it will be of great use to the practical man, as well as of interest to the student. It is very fully illustrated and can be confidently recommended to electricians.

SCIENTIFIC AMERICAN
BUILDING EDITION.

MAY, 1894.—(No. 103.)

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1. Elegant plate in colors showing a handsome residence recently erected for William H. Bartlett, Esq., at Evanston, Ill. Two perspective views and floor plans. Mr. J. L. Silsbee, architect, Chicago, Ill. A very picturesque design.
2. Plate in colors showing a cottage at Mt. Vernon, N. Y., recently completed for E. J. Walther, Esq. Two perspective views and floor plans. Mr. L. H. Lucas, architect, Mt. Vernon, N. Y. An excellent design.
3. Cottage at Morgan Park, Ill., recently erected for G. F. Patterson, Esq., at a cost of $3,000 complete. Two perspective views and floor plans. Mr. H. H. Waterman, architect, Chicago, Ill.
4. A summer house at Southampton, Long Island, N. Y., recently completed for H. M. Day, Esq. Two perspective views and floor plans. A model design. Messrs. G. E. Harney & W. S. Purdy, architects, New York.
5. A residence at Portchester, N. Y., recently erected for Walter S. Haviland, Esq. Two perspective views and floor plans. A very pleasing design. Mr. Louis Mertz, architect, Portchester, N. Y.
6. Floor plans, interior view, and two perspectives of a residence recently completed at Hackensack, N. J., for George A. Vroom, Esq. An excellent design and unique plan. Cost complete $6,950. Mr. Christopher Meyer, architect, New York City.
7. The Barnum Institute of Science and History, of Bridgeport, Conn., donated by the late Phineas T. Barnum. A one-half page perspective view. Cost for building and grounds $100,000. A fine example of the Romanesque style of architecture.
8. A residence at Stamford, Conn., recently erected for Oliver G. Fessenden, Esq., at a cost of $5,199. Two perspective views and floor plans. Mr. Wm. H. Day, architect, New York City. A very pleasing design.
9. A cottage of moderate cost recently completed for Hiram R. Smith, Esq., at Randall Park, Freeport, Long Island, N. Y. Cost complete $3,900. Two perspective views and floor plans. Mr. Wm. Raynor, Freeport, Long Island, N. Y., architect. A very attractive design.
10. "Otter Cottage," recently completed for Henry H. Adams, Esq., at Belle Haven Park, Greenwich, Conn. Mr. H. W. Howard, architect, Greenwich, Conn. An attractive design in the colonial style of architecture. Two perspective views and floor plans.
11. A colonial cottage at "The Bluffs," Mt. Vernon, N. Y., recently completed for E. A. Hunt, Esq. Two perspective views, an interior view and floor plans. Mr. Louis H. Lucas, architect, Mt. Vernon, N. Y.
12. Half-page engraving showing hall and staircase of a London dwelling.
13. Miscellaneous Contents: Clients' right of replicating design.—Shop and mill construction.—Seasoning oak.—Beautiful designs in parquetry work, illustrated.—The effect of fire on concrete.—Waterproof cellars.—Embossing wood.—Steel butt with ball-bearing washers, illustrated.—"The Holland" radiators, illustrated. — Graphite paint. — Sandpapering machines.—The Van Wagoner & Williams Hardware Company.—Window screens and screen doors.—Maple flooring.—The Pullman sash balance, illustrated.—Portland cement walks.—Subterranean London.—An alloy which adheres to glass.—A saw clamp and filing guide, illustrated.

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Distance Reading Thermometers.—See illus. advertisement, page 255. Ward & Doron, Rochester, N. Y.

Cheapest Water Power.—See top of 1st column, page 170. Also top of 2d column, page 239. Look, it will pay.

Screw machines, milling machines, and drill presses. The Garvin Mach. Co., Laight and Canal Sts., New York.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4; Munn & Co., publishers, 361 Broadway, N. Y.

Patent Electric Vise. What is claimed, is time saving. No turning of handle to bring jaws to the work, simply one sliding movement. Capital Mach. Tool Co., Auburn, N. Y.

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(6049) H. D. says: Not long since a man was traveling through this section selling a preparation to remove warts, corns, etc. It only required two or three minutes to remove them. Of what substances and proportion was his preparation, and is there any danger in its use?

A. Salicylic acid ..... 30 grn.
Cannabis Indica (Indian hemp) ..... 5 "
Castor oil ..... ½ drm.
Collodion ..... ½ oz.

Mix and apply morning and evening for four days. Then soak the feet in warm water. If this be done faithfully, the corns are removed without any difficulty. The result is a clear light green solution. There should be no difficulty in its preparation. To prevent it from evaporating, keep the solution in a stoppered bottle. Be sure and use the Indian hemp, and not the American article; the latter is not easily soluble. We would not advise the use of any such preparation as you describe, as it is probably harmful. The formula given above is harmless.

(6050) J. C. asks for a negative varnish:

A. Try

Sandarac ..... 4 ounces.
Alcohol ..... 28 "
Oil of lavender ..... 3 "
Chloroform ..... 5 drachms.

Another is

Methylated spirit ..... 12 ounces.
Light amber shellac ..... 1½ "
Sandarac ..... 1½ "
Canada balsam ..... ½ drachm.
Oil of lavender ..... ½ ounce.

Before varnishing the film should be perfectly dry, and it will be well to heat it a little. Before printing from the varnished negative, warm the surface to evaporate all moisture that may adhere there. If these precautions are taken, there should be no staining of the film. 2. What will remove the silver stain caused by the film of aristo paper adhering to the surface of the negative? A. Usually the stain can be removed by rubbing it lightly with a tuft of absorbent cotton wetted with a weak solution of cyanide of potassium, previously soaking the negative for 10 minutes in a solution of iodide of potassium, 20 grains to 1 ounce of water. Gihon's opaque, we think, is made similar to water colors cakes usually sold, to artists and others. A cheap substitute would be a mixture of alcohol, shellac, and lampblack, which may be thinned or thickened as desired, with alcohol, and applied with a brush.

(6051) E. & M. ask: 1. Does the plane or convex side of a single plano-convex lens go next the sensitive plate in the "Photoret"? A. The convex. 2. Will the same answer apply to a single achromatic Waterbury lens? A. Yes. 3. Will you be kind enough to give us a formula for metol developer? A. Metol 5 grains, sodium sulphite 3 grains, water 1 ounce, add carbonate of potash 2 grains. 4. What is metol? A. The chemical name is monomethylparamidometacreosote. It is a derivative from coal tar. 5. What is hydrochinone? A. A derivative of cinchona bark. 6. Is para-amidophenol hydrochlorate injurious to use? A. No.

(6052) A. H.—1. Electrotypes of half tone blocks are used for printing from. 2. Carbon tissue can be had of the photo. dealers in different colors and is printed in the same manner as other photos.

(6053) J. E. W. asks: What is the largest number of shots on record fired by a Gatling gun per minute, and where was it done? A. The Gatling gun at the trials at Shoeburyness, England, was fired 400 rounds per minute. Later by improvements it is claimed to have been fired 100 rounds per minute, in each of its 10 barrels, or 1,000 rounds per minute. About 600 rounds per minute is the average practice of the best machine guns.

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An experience of forty-four years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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May 15, 1894,

AND EACH BEARING THAT DATE.

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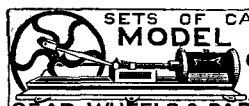

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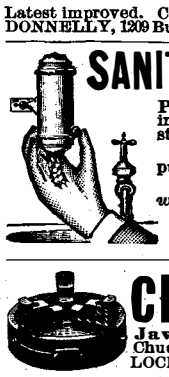

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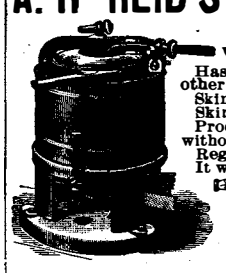

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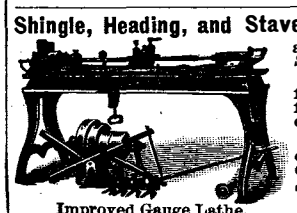

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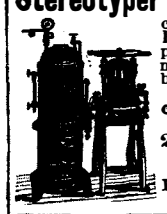

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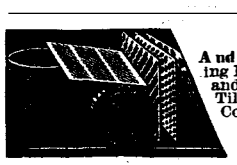

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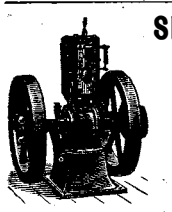

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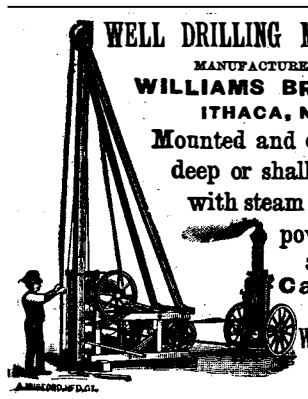

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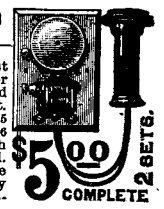

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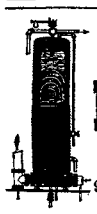

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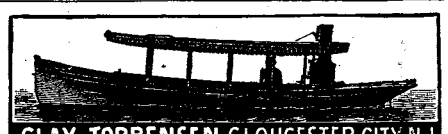

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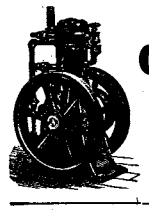

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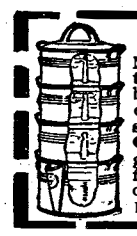

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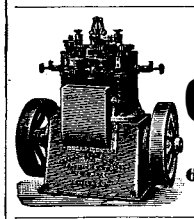

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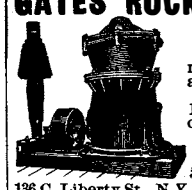

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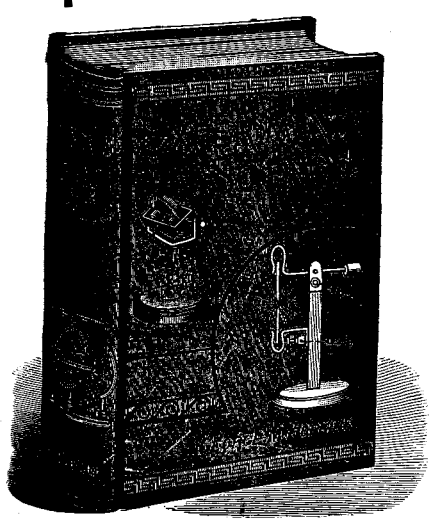

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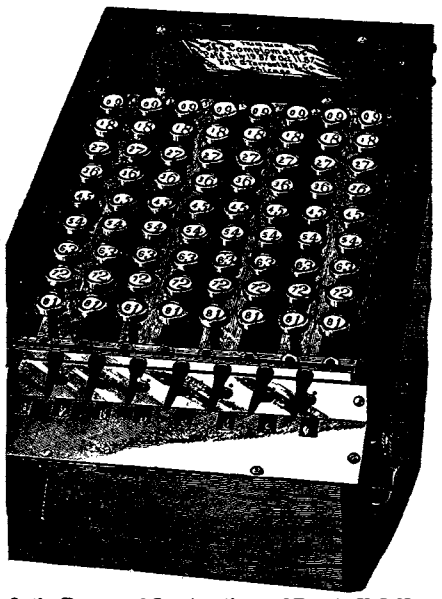

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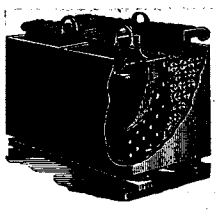

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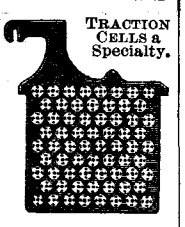

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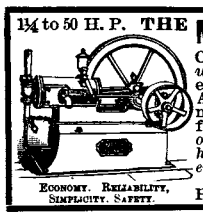

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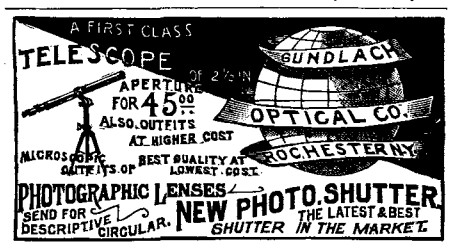

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